



Dipartimento di Impresa e Management

Corso di Laurea in Management

Cattedra di Managerial Decision Making

THE MARKET FOR CONCRETE AND OTHER INPUTS OF THE BUILDING
INDUSTRY : CURRENT TRENDS AND FUTURE PERSPECTIVES. THE CASE OF
CELI CALCESTRUZZI SPA

Prof. Luigi Marengo
Marengo

RELATORE

Prof. Luigi

CORRELATORE

Salvatore Celi

CANDIDATO

Matr.788911

Anno Accademico 2024/2025

INDICE :

Introduction pp. 4

Chapter 1: Theoretical Framework pp.7

1.1 Managerial decision-making theories pp.7

1.2 Market structure and competitive forces (Porter's Five Forces) pp.10

1.3 Game theory and strategic interactions pp.14

1.4 Supply chain and operational efficiency in the construction industry pp.18

1.5 Regulatory and environmental considerations pp. 21

Chapter 2: Industry Analysis: The Market for Concrete and Building Materials pp. 25

2.1 Market overview and key trends pp. 25

2.2 Raw material availability and cost fluctuations pp. 28

2.3 Environmental regulations and sustainability challenges pp. 32

2.4 Technological Innovation and Digital Transformation pp. 36

2.5 Competitive landscape and strategic positioning pp. 38

Chapter 3: Case Study – Celi Calcestruzzi S.p.A. pp. 42

3.1 Company background and market positioning pp. 42

3.2 Strategic decisions and competitive strategies pp. 44

3.3 Pricing strategies and cost structures pp. 47

3.4 Adaptation to environmental, regulatory, innovations and future challenges pp. 51

3.5 Strategic Analysis through Porter's Five Forces and Game Theory pp. 54

Chapter 4: Discussion and Implications pp. 60

4.1 Key findings from industry analysis and case study pp. 60

4.2 Theoretical and practical implications for the construction industry pp. 64

4.3 Strategic recommendations for firms in the sector pp. 67

4.4 Limitations of the study and future research directions pp. 70

Conclusion pp. 75

Bibliography pp. 79

INTRODUCTION

The strategic dimension of decision-making processes in industrial sectors is a pivotal theme in contemporary managerial studies. Among the industries characterized by high levels of capital intensity, cyclical demand, and regulatory complexity, the construction materials industry—and particularly the concrete market—holds a position of both strategic and economic significance. As one of the primary inputs for the construction sector, concrete represents a cornerstone for infrastructural development, urban expansion, and industrial activity. The study of strategic behavior in this domain is not only relevant to the academic understanding of market dynamics but also critical for managerial practice in firms navigating this competitive landscape.

Despite its importance, the concrete industry has often been examined from operational or engineering standpoints, with limited attention to its strategic underpinnings. The interplay of market forces, regulatory shifts, and technological innovation creates an environment of strategic interdependence, where each firm's choices are inextricably linked to those of competitors, regulators, and supply chain partners. Within this context, the theoretical apparatus of game theory and strategic interaction provides a compelling framework for analyzing and predicting firm behavior. In this regard, the textbook *Strategy* by Joel Watson offers a structured and rigorous foundation for understanding how decision-makers operate under conditions of strategic uncertainty, incomplete information, and interdependent preferences.

This thesis seeks to contribute to the theoretical and practical understanding of strategic decision-making within the concrete industry. Specifically, it aims to apply the models and concepts elaborated in Watson's framework to the real-world context of Celi Calcestruzzi S.p.A., an Italian firm operating in the concrete sector. By bridging the theoretical insights of noncooperative and cooperative game theory with empirical observations from the industry, this study endeavors to provide a nuanced perspective on how firms formulate and execute strategic decisions. In doing so, it addresses a gap in the

literature by extending game-theoretic reasoning to a sector often overlooked in strategic analysis, despite its structural complexities and economic relevance.

The central objective of this research is to elucidate the strategic mechanisms that govern firm behavior in the concrete industry, particularly in relation to market competition, pricing dynamics, and regulatory adaptation. Drawing upon the conceptual tools offered in Watson's textbook, the thesis investigates how firms anticipate the actions of their rivals, negotiate contractual arrangements, and respond to shifts in environmental constraints. The research is guided by a set of interrelated questions, namely: How do the principles of strategic interaction apply to the decision-making processes within the concrete industry? What kinds of competitive and cooperative tensions emerge in this market? How can the behavior of firms such as Celi Calcestruzzi S.p.A. be interpreted through the lens of game-theoretic equilibrium concepts? And finally, what normative insights can be derived to inform managerial practice in this sector?

The methodological approach adopted in this thesis is grounded in a qualitative and conceptual analysis, informed by theoretical modeling and case study evaluation. The first part of the thesis develops a robust theoretical framework based on foundational game-theoretic principles, including rationality, dominance, best-response functions, and Nash equilibrium. It further explores dynamic considerations such as subgame perfection, repeated interactions, and reputation effects, which are particularly salient in oligopolistic industries such as concrete manufacturing. These concepts are not presented in abstraction but are contextualized through stylized examples and analytical models that mirror the strategic challenges faced by firms in the sector.

In the second part, the thesis applies this framework to a detailed examination of the Italian concrete market, with a specific focus on Celi Calcestruzzi S.p.A. The firm is analyzed as a strategic actor embedded within a network of competitors, suppliers, and institutional stakeholders. Information will be sourced from company reports, public documentation, and—where available—direct interactions with company

representatives. The aim is not to conduct statistical hypothesis testing, but rather to use the tools of theoretical reasoning to interpret real-world phenomena. The methodological rigor of the study lies in the careful construction and application of models that capture the strategic essence of industry interactions, allowing for the generation of analytically sound and managerially relevant conclusions.

To achieve these aims, the thesis is structured into six chapters, each building upon the previous to establish a coherent and cumulative argument. The first chapter introduces the study, outlines its motivations, and sets the stage for the subsequent analysis. The second chapter presents the theoretical foundations, elaborating on the key concepts and frameworks derived from Watson's Strategy. The third chapter offers a comprehensive overview of the concrete industry, examining market trends, structural characteristics, and strategic challenges. Chapter four delves into the case study of Celi Calcestruzzi S.p.A., applying the theoretical tools to analyze the firm's strategic posture. The fifth chapter discusses the broader implications of the findings, both in terms of theory and practice. Finally, the sixth chapter synthesizes the main insights and proposes directions for future research.

This integrative structure reflects the ambition of the thesis: to contribute to academic discourse on strategic decision-making while providing actionable insights for industry practitioners. By situating the study within a rigorous theoretical framework and grounding it in a concrete empirical context, the thesis aspires to demonstrate the value of strategic reasoning in industrial sectors that are often underrepresented in management literature. The ultimate aim is to offer a compelling synthesis of theory and practice, illuminating how abstract models can inform real-world decisions in complex, competitive environments.

CHAPTER 1: Theoretical Framework

1.1 Managerial decision-making theories

Managerial decision-making is a field of inquiry that investigates how individuals and organizations formulate, evaluate, and implement strategic choices in environments characterized by uncertainty, complexity, and interdependence¹. In industries marked by imperfect information, dynamic competition, and multiple stakeholders—as is the case with the building materials sector—decision-makers must operate within a landscape shaped not only by internal objectives, but also by the anticipated reactions of external agents. The ability to navigate such complexity is at the core of strategic management.

A foundational lens through which this complexity can be systematically understood is game theory². As conceptualized in Watson's *Strategy*, game theory offers a formalized approach to analyzing decision-making situations where the outcome of a given strategy depends crucially on the strategies adopted by others. This interdependence of outcomes lies at the heart of strategic thinking and compels managers to anticipate, interpret, and respond to the likely actions of rivals, partners, regulators, and other market participants. As Watson notes, strategic situations are characterized by "the need to consider how others choose their actions" to determine one's own optimal behavior³.

The theoretical models employed in this framework aim to capture the essence of strategic interaction. Two core representations—the extensive form and the strategic (or normal) form—provide complementary ways of structuring such interactions. The extensive form is especially valuable in situations involving sequential decisions, where the timing of moves and the availability of information are pivotal. In contrast, the strategic form captures simultaneous choices, making it particularly suited for competitive environments

¹ March, J. G. (1994). *A Primer on Decision Making*. Free Press

² Watson, J. (2018). *Strategy: An Introduction to Game Theory*, 3rd ed., Norton.

³ Watson J Ibid., p.131

such as pricing decisions in homogeneous product markets. Both approaches allow the derivation of central concepts like best response, equilibrium, and strategic dominance.

These theoretical constructs have significant implications for managerial decisions. Consider, for example, a firm deciding whether to enter a market already occupied by a few large players. Modeling this scenario as a strategic interaction reveals that the expected responses of incumbents—such as price cuts or capacity adjustments—should inform the entrant's initial strategy. In this sense, a firm's decision is not made in isolation but emerges from a rational anticipation of other actors' behaviors.

A further layer of complexity is introduced when one considers uncertainty and incomplete information. In practical terms, managers rarely have perfect knowledge about their competitors' costs, preferences, or intentions. Strategic models thus often incorporate probabilistic beliefs and expected payoffs, enabling a more realistic assessment of risk and opportunity⁴. Watson illustrates this point by highlighting the role of beliefs and expectations in shaping mixed strategies, where randomness is used not due to irrationality, but as a calculated response to strategic ambiguity.

One of the most salient insights from this literature is the recognition of strategic tensions—situations where individually rational behavior leads to collectively suboptimal outcomes. The classic prisoner's dilemma exemplifies how firms may be driven toward mutual price undercutting, despite higher profits being attainable through implicit cooperation⁵. This tension is often observable in markets like concrete production, where regional players may erode their margins in a race to win contracts, despite long-term benefits being achievable through stability and differentiation.

In addition to competitive scenarios, decision-making often involves contractual or cooperative dimensions. Managers must consider how to structure relationships with suppliers, clients, and regulatory authorities, frequently under conditions of asymmetric

⁴ Watson, *Strategy*, ch. 10

⁵ *Ibid.*, p. 163

information or weak enforcement. Strategic models that integrate notions of commitment, negotiation, and incentive alignment offer important guidance in these settings. Contracts are not merely legal artifacts but are seen, within this framework, as mechanisms to shape strategic behavior, align incentives, and mitigate opportunism.

Repeated interactions and reputation further enrich the strategic landscape. In markets characterized by frequent transactions and a limited number of participants, historical behavior can influence expectations and thus constrain future choices. A firm that consistently honors agreements or maintains stable pricing may cultivate a reputation that deters opportunistic behavior by others. As Watson remarks, “the shadow of the future” can sustain cooperative outcomes even in the absence of formal enforcement.

In conclusion, managerial decision-making theories rooted in strategic reasoning offer a powerful toolkit for interpreting the behavior of firms in interdependent environments. By abstracting real-world complexity into logically consistent models, these theories enable managers to better anticipate the consequences of their choices and to design strategies that account for both competitive threats and collaborative opportunities. For sectors such as concrete manufacturing—where decisions on pricing, investment, and regulation are deeply influenced by the behavior of others—this theoretical foundation proves particularly relevant. Rather than offering a deterministic view of strategy, game-theoretic reasoning encourages a disciplined approach to understanding and navigating the multifaceted realities of modern industrial competition ⁶.

1.2 Market structure and competitive forces (Porter's Five Forces)

The theoretical examination of market structure is a foundational component of strategic analysis, providing the conceptual scaffolding upon which more applied evaluations of industry conditions can be constructed. One of the most enduring and influential frameworks in this regard is Michael E. Porter's Five Forces model, which delineates the structural determinants of competition within an industry⁷. Rather than limiting the scope of analysis to direct competitors, the model identifies five sources of competitive pressure: rivalry among existing firms, the threat of new entrants, the bargaining power of suppliers, the bargaining power of buyers, and the threat posed by substitute products.⁸ Each force serves as a lens through which the intensity and configuration of competition can be understood.

Porter's framework offers a structured methodology for diagnosing the underlying economic and institutional features that shape industry profitability. It draws attention to the fact that competitive strategy is not formulated in a vacuum but in response to systemic pressures that constrain or enable firm behavior. These forces do not operate in isolation but are interrelated and often reinforce one another. For instance, high supplier power may amplify the effects of intense rivalry, while low entry barriers may heighten the threat posed by substitutes. A central insight of the model is that the collective strength of these forces determines the potential for value creation and capture in a given industry. The framework thus encourages strategic analysis that is rooted in structural realism, taking account of enduring industry characteristics rather than transitory fluctuations.

From a theoretical standpoint, the Five Forces framework is deeply compatible with principles found in economic theory and game-theoretic reasoning. While Porter's approach is rooted in industrial organization economics, it shares with game theory a concern for strategic interaction and equilibrium behavior. Competitive rivalry, for instance, can be modeled as a repeated game in which firms adjust their actions in anticipation of rival responses. This aligns with Watson's treatment of iterated strategic

⁷ Porter, M. E. (1980). *Competitive Strategy: Techniques for Analyzing Industries and Competitors*. Free Press.

⁸ Porter, 1980 pp. 87

environments, in which players form beliefs about others' strategies over time and adapt accordingly. Similarly, the threat of entry may be conceptualized as a sequential game, where incumbents take anticipatory actions—such as capacity expansion, product proliferation, or pricing commitments—to alter the payoff structure for potential entrants.⁹

The bargaining power of suppliers and buyers introduces further strategic complexity. These forces can be interpreted through the lens of bilateral monopoly models or bargaining games in which each party seeks to maximize its share of the surplus under conditions of incomplete information. The relative power of each side is shaped by factors such as concentration, switching costs, and the availability of alternatives. Watson's exploration of bargaining theory provides a useful parallel, especially when he discusses how information asymmetries and the threat of breakdown shape negotiated outcomes. In practical terms, strategic actors must recognize that the surplus in a negotiation is not fixed *ex ante* but can be expanded or constrained by institutional design, long-term commitments, or signaling strategies.

The threat posed by substitutes, meanwhile, introduces an intertemporal and cross-market dimension to strategic planning. Substitution alters the elasticity of demand and can erode long-term profitability by offering customers functionally equivalent alternatives that may be cheaper, more efficient, or more sustainable. This threat can be explored using models of monopolistic competition or innovation races, in which firms compete not only within their market but also with emerging alternatives¹⁰. Substitution is also central to dynamic game models that incorporate belief updating and strategic foresight, elements that Watson emphasizes in his discussions of forward-looking behavior. Here, the ability of a firm to anticipate trends, invest in R&D, and influence consumer preferences becomes crucial to maintaining strategic viability.

While the Five Forces model is not prescriptive in nature, it serves as a powerful diagnostic framework that sharpens strategic awareness. It prompts managers and

⁹ Watson, *Strategy*, ch. 5

¹⁰ Tirole, J. (1988). *The Theory of Industrial Organization*. MIT Press.

analysts to assess not only the immediate competitive environment but also the broader structural conditions that influence firm behavior over time. In this respect, the model is not static but dynamic, as changes in one force can reverberate across the entire competitive system. For example, innovation that reduces dependence on powerful suppliers may simultaneously weaken buyer power and deter new entrants, thus reshaping the industry equilibrium. Similarly, vertical integration by dominant players may alter the balance of power in supplier relationships while raising entry barriers for competitors.

Porter's framework is also valuable for its emphasis on external forces rather than internal capabilities. It encourages a form of strategic thinking that prioritizes adaptation and alignment over introspection. This external orientation is theoretically aligned with the concept of strategic fit, where the effectiveness of a firm's strategy depends on its congruence with the surrounding competitive landscape. Strategic fit, as discussed in Watson's broader game-theoretic models, is not merely a matter of matching resources to opportunities but also of anticipating how others will respond to one's strategic posture.¹¹ Moreover, understanding structural forces enables firms to move beyond reactive strategies and toward proactive shaping of the competitive environment through lobbying, standard-setting, alliance formation, and market segmentation.

It is important to recognize that the Five Forces framework, while broadly applicable, does not offer quantitative predictions or equilibrium solutions. Its strength lies in qualitative diagnosis, which must then be supplemented by more formal modeling when strategic precision is required. In this way, the framework complements, rather than competes with, the deductive rigor of game-theoretic analysis. For instance, once a key competitive pressure—such as buyer power—is identified, formal models of auction theory or pricing games may be employed to refine strategic options and assess trade-offs more precisely.

In summary, the Five Forces model provides a theoretically rich foundation for understanding the determinants of industry structure and the strategic challenges firms

face. Its utility lies in its ability to decompose complex competitive environments into analytically tractable elements, facilitating a deeper understanding of how firms can position themselves to achieve sustainable advantage. When combined with game-theoretic reasoning, the model enables a rigorous and nuanced interpretation of strategic behavior, offering a bridge between structural analysis and strategic action. While this chapter has focused exclusively on the theoretical foundations of the model, the subsequent analysis will apply these concepts to the specific dynamics of the concrete industry, where each of the five forces manifests in unique and strategically significant ways.

1.3 Game Theory and Strategic Interactions

Game theory represents one of the most robust theoretical foundations for analyzing strategic behavior in competitive environments¹². Originating in the fields of mathematics and economics, game theory provides a formal structure to model situations where the outcome for each agent depends not only on their own actions but also on the actions of others. In the realm of strategic management, this interdependence is a defining feature of decision-making contexts, particularly in oligopolistic industries, regulated markets, or any environment characterized by strategic rivalry, contractual negotiations, or collaborative alliances.

At its core, game theory rests on several foundational assumptions: players are rational, they aim to maximize their own utility or payoff, and they form expectations about the behavior of other players. This rationality assumption is central to the analysis of strategic interactions, as it allows for the prediction of outcomes based on equilibrium concepts. As Watson emphasizes, “a solution to a game is a prediction about what the players will do” and hinges on “each player doing the best they can, given what they believe the others are doing.” This focus on interdependent expectations underscores the sophistication of managerial decisions in environments marked by uncertainty and competition.

One of the most fundamental concepts in game theory is the Nash equilibrium, a solution concept in which no player can improve their outcome by unilaterally changing their strategy, assuming the strategies of others remain unchanged. The power of this concept lies in its wide applicability, spanning scenarios from duopolistic price competition to complex strategic alliances. Nash equilibria may be in pure strategies, where each player consistently chooses one action, or mixed strategies, where randomization is used to obscure intentions or balance conflicting incentives¹³. Watson’s analysis illustrates how these equilibria can yield counterintuitive insights in both cooperative and adversarial settings, providing clarity in otherwise opaque strategic dilemmas.

12 Osborne, M. J., & Rubinstein, A. (1994). *A Course in Game Theory*. MIT Press

13 Nash, J. F. (1950). *Equilibrium Points in n-Person Games*. *Proceedings of the National Academy of Sciences*, 36(1), 48–49.

The strategic form, or normal form, of a game offers a tabular representation that emphasizes simultaneous decision-making. In this framework, players select strategies without knowledge of others' choices, reflecting many real-world scenarios in competitive markets. Concepts such as dominant strategies and best-response mappings emerge naturally from this form, enabling systematic evaluation of rational choices and facilitating comparative statics across different competitive configurations.

Conversely, the extensive form of a game captures sequential decision-making through tree-like diagrams that outline the order of moves, decision nodes, and available information. This structure introduces critical dynamic considerations such as first-mover advantage, credible commitment, and path dependency. Watson provides detailed illustrations of extensive-form games using backward induction, particularly highlighting subgame perfect equilibrium as a refinement of Nash equilibrium¹⁴. This refinement requires strategies to constitute Nash equilibria in every subgame, ensuring internal consistency and ruling out implausible or non-credible threats—a necessity in dynamic managerial contexts.

Repeated games, wherein players interact over multiple periods, introduce additional layers of complexity and strategic richness. These games permit the exploration of reputation, trust-building, and enforcement mechanisms that are often absent in one-shot games. The folk theorem, a central result in this area, asserts that a multitude of equilibria can be sustained in infinitely repeated interactions, provided players are sufficiently patient. Watson highlights how this repeated interaction enables both punitive and cooperative equilibria, depending on the discounting of future payoffs and institutional context.

Equally important is the analysis of strategic interaction under asymmetric information. Games of incomplete information, such as signaling and screening games, address the challenges posed by hidden characteristics or private knowledge. Signaling models involve informed players transmitting credible messages through costly actions—like

pricing, advertising, or investment—while screening involves mechanisms designed by uninformed players to elicit private information. Watson’s exposition of Bayesian games and perfect Bayesian equilibrium integrates beliefs and strategies into a consistent analytical framework, shedding light on the strategic manipulation of information in business settings.

Additionally, Watson introduces refinements and solution concepts like trembling-hand perfection, which ensure the robustness of equilibria under slight perturbations in behavior, and forward induction, which considers rationalization of early moves in a game¹⁵. These advanced concepts further nuance strategic analysis, accommodating the subtle reasoning processes managers must engage in when anticipating rivals’ responses or crafting long-term strategy.

The incorporation of game-theoretic logic into strategic decision-making enables managers to better comprehend interdependencies, craft adaptive strategies, and structure incentives to align with organizational objectives. Though game theory offers elegant models, its application requires careful contextualization and awareness of real-world frictions. In this thesis, game theory will serve as a foundational tool to examine competitive behaviors and strategic interactions, with its conceptual richness drawn primarily from Watson’s extensive treatment and other complementary scholarly sources.

Game theory finds significant application in the analysis of competitive markets, especially in oligopolistic contexts where the decisions of one firm directly influence the choices of others. Classic models such as Cournot and Bertrand competition illustrate how firms compete respectively on quantity and price, highlighting the strategic dynamics that emerge in such environments. In the Cournot model, firms simultaneously decide the quantities to produce, assuming that competitors' decisions remain unchanged, leading to a Nash equilibrium in which no firm has an incentive to deviate unilaterally. In contrast, in the Bertrand model, firms compete on prices, and the resulting equilibrium may lead to prices equal to marginal cost, thereby eliminating economic profits.

Another relevant model is the Stackelberg competition, which introduces a temporal sequence in decision-making, with a leading firm choosing the quantity to produce first, followed by a follower firm that reacts to this decision. This model underscores the importance of first-mover advantage and the role of credible commitment strategies.

These models offer useful analogies for understanding strategic interactions in real markets, where firms must anticipate competitors' actions and adapt their strategies accordingly. The application of game theory in such contexts enables the analysis and prediction of behaviors such as cartel formation, price wars, and entry deterrence strategies.

1.4 Supply chain and operational efficiency in the construction industry

The concept of supply chain management (SCM) has evolved into a central pillar of strategic thinking across industries, reflecting the increasing complexity and interdependence of modern production and delivery systems ¹⁶. At its core, SCM is concerned with the coordination and integration of all activities involved in sourcing, procurement, production, and logistics, with the overarching objective of delivering value to the end customer while optimizing resources and minimizing inefficiencies. In theoretical terms, supply chains can be viewed as networks of autonomous but interlinked decision-making entities, each pursuing its own objectives while being constrained by the actions and constraints of others. This interdependency aligns closely with the principles explored in strategic management and game theory.

From a strategic standpoint, the effectiveness of a supply chain hinges on its ability to align operational decisions with long-term competitive goals. Efficiency in this context refers not only to cost reduction but also to flexibility, responsiveness, and resilience—qualities that have become particularly salient in an era marked by global uncertainty, just-in-time production models, and volatile input markets. Classical operations research and systems theory contribute foundational models to this analysis, offering structured ways to optimize flows, allocate resources, and manage inventories under uncertainty. These include linear programming, queuing theory, and simulation models, which provide quantitative tools to balance trade-offs in multi-agent systems.

Watson's framework offers relevant insights for understanding how firms navigate strategic interdependence within supply chains. While primarily focused on strategic interaction, the underlying logic of rational decision-making under constraints and incomplete information also applies to supply chain coordination. For instance, the negotiation between a buyer and a supplier over pricing, quantity, and delivery terms can be conceptualized as a dynamic game with asymmetric information and repeated interaction. Such situations require careful alignment of incentives to avoid opportunism

and ensure mutually beneficial outcomes—elements central to relational contracting theory and transaction cost economics.

The structure of supply chains is often analyzed through the lens of vertical integration and outsourcing decisions, where firms must weigh the costs and benefits of internalizing production versus leveraging external partners. Theories of the firm, such as those advanced by Coase and Williamson, emphasize the role of transaction costs, asset specificity, and contract enforceability in shaping these decisions¹⁷. Firms seek to minimize coordination failures and inefficiencies by structuring governance mechanisms that balance flexibility with control. These theoretical considerations are particularly relevant in fragmented industries, where coordination challenges are amplified.

Operational efficiency within supply chains also draws heavily from lean management principles. Rooted in the Toyota Production System, lean thinking emphasizes the elimination of waste (*muda*), continuous improvement (*kaizen*), and the pursuit of value from the customer's perspective. Concepts such as value stream mapping, takt time, and pull systems are widely applied in operations management theory to enhance process flow and reduce non-value-adding activities. Lean theory intersects with strategic management by highlighting how operational capabilities can become a source of sustained competitive advantage, especially when they are difficult to replicate and embedded in organizational routines.

Another key theoretical dimension is the role of information and technology in enabling coordination and integration. The advent of digital supply chains, supported by enterprise resource planning (ERP) systems, cloud platforms, and advanced analytics, has transformed the way firms forecast demand, manage inventory, and coordinate logistics¹⁸. Theoretical models of information sharing, such as those developed in principal-agent theory and signaling games, help explain how transparency and trust can be enhanced across the supply chain, reducing uncertainty and facilitating cooperative outcomes.

¹⁷ Coase, R. H. (1937). *The Nature of the Firm*. *Economica*, 4(16), 386–405

¹⁸ Davenport, T. H., & Harris, J. G. (2007). *Competing on Analytics*. Harvard Business Press

Moreover, resilience and risk management have become central themes in supply chain theory, particularly in light of recent global disruptions. Theories of redundancy, flexibility, and adaptability are now integrated into supply chain design, challenging earlier paradigms that prioritized lean optimization at the expense of robustness. The trade-off between efficiency and resilience is increasingly seen as a strategic decision, where firms must model and manage the probability and impact of rare but severe events—drawing on decision theory, scenario planning, and real options analysis.

In sum, the theoretical study of supply chain and operational efficiency draws on a diverse range of disciplines, including economics, strategic management, operations research, and organizational theory. These frameworks converge on the recognition that effective supply chains are not merely logistical systems, but strategic architectures that influence and are influenced by competitive dynamics. The insights developed here will serve as the foundation for the subsequent empirical and sector-specific analysis, in which these concepts will be applied to the construction industry and its associated supply networks.

1.5 Regulatory and environmental considerations

The strategic decision-making process within firms is increasingly influenced by the evolving landscape of regulatory and environmental constraints. From a theoretical standpoint, regulations function as external parameters that redefine the feasible set of strategic actions available to firms, often altering payoffs and creating new incentive structures. In this context, regulatory environments are not simply constraints, but dynamic components of the strategic ecosystem, capable of shaping market structure, competitive behavior, and long-term sustainability. As Watson emphasizes, “strategic decision-making is always subject to the context in which the player operates,”¹⁹ and this context often includes binding legal, environmental, and institutional frameworks that must be internalized by rational actors.

At the core of regulatory theory lies the concept of market failure, where unregulated market mechanisms fail to allocate resources efficiently due to the presence of externalities, public goods, information asymmetries, or monopolistic practices. Governments and supranational institutions intervene in these contexts to correct inefficiencies, protect stakeholders, and ensure the sustainability of natural and social systems. In the case of environmental regulations, this typically involves internalizing negative externalities—such as pollution, resource depletion, or greenhouse gas emissions—through mechanisms like taxes, quotas, standards, or market-based instruments such as cap-and-trade systems. These interventions fundamentally alter the payoff matrices in strategic games, compelling firms to incorporate environmental costs into their decision-making calculus.

The interaction between regulation and strategy can be theoretically framed within the logic of non-cooperative games with exogenous constraints. For example, when environmental compliance imposes a cost on firms, the structure of competitive equilibria may shift—rewarding early adopters of clean technologies or penalizing laggards through reputational damage and reduced market access. In repeated-game settings, regulation may also play a role in enabling collusive behavior or long-term cooperation, by formalizing behavioral norms and reducing uncertainty about rivals' intentions. This

interplay highlights the importance of credible commitment and regulatory predictability, which reduce the volatility of strategic expectations and foster stable equilibria.

Another relevant theoretical framework is institutional theory, which examines how formal rules, informal norms, and cultural-cognitive elements shape organizational behavior. Regulatory regimes are not merely imposed from above but are often co-constructed through political, legal, and industrial processes. Firms respond to these institutions not only through compliance but also through strategic adaptation, lobbying, or even proactive standard-setting. In this sense, regulation becomes both a constraint and a source of competitive differentiation, particularly in industries where legitimacy and public trust are central to value creation.

Environmental considerations, in particular, have become integral to strategic planning due to the global shift towards sustainability and the rise of stakeholder capitalism. The triple bottom line framework—focusing on people, planet, and profit—has expanded the evaluative criteria by which firm performance is measured, moving beyond short-term financial returns to incorporate social and environmental impacts. This broader perspective aligns with theories of corporate social responsibility (CSR) and shared value, which posit that long-term strategic advantage can emerge from addressing societal challenges in ways that also enhance firm competitiveness²⁰.

From an operations standpoint, environmental regulation intersects with supply chain management, as firms are required to trace the environmental footprint of their entire value chain. Theories of green supply chain management and life-cycle assessment provide systematic approaches to model and optimize these impacts, linking upstream sourcing decisions with downstream waste management and product stewardship. In this framework, regulatory compliance becomes a system-wide coordination problem, requiring transparency, information sharing, and collaboration across organizational boundaries.

Theoretical approaches to environmental uncertainty also emphasize the role of flexibility and dynamic capabilities. In regulatory contexts characterized by ambiguity, firms that can reconfigure their assets, adapt routines, and absorb shocks gain a strategic advantage. This perspective draws from real options theory, which conceptualizes investment under uncertainty as a series of contingent decisions, each preserving or expanding future

strategic choices. Environmental volatility, in this sense, demands not only compliance but also agility in resource allocation and innovation management.

Finally, game theory provides valuable insights into how firms anticipate and respond to regulatory moves. Governments and regulators can be seen as strategic players themselves, whose actions are shaped by political, economic, and informational constraints²¹. The interactions between firms and regulators may thus be modeled as strategic games, involving signaling, commitment, and repeated interaction. These dynamics influence the design of compliance strategies, the credibility of regulatory enforcement, and the incentives for proactive behavior or circumvention.

In conclusion, regulatory and environmental considerations are not exogenous nuisances to be managed passively, but core components of the strategic environment that shape behavior, redefine incentives, and offer new avenues for value creation. By incorporating insights from regulatory economics, institutional theory, and strategic interaction, firms can better navigate the complexities of governance, compliance, and sustainability. The theoretical foundations developed in this section will inform later chapters, where these dynamics will be analyzed in sector-specific contexts.

This chapter has established a comprehensive theoretical foundation for analyzing strategic decision-making within complex and regulated industries. By integrating concepts from strategic management, game theory, supply chain optimization, and institutional economics, we have constructed a multidimensional framework that captures the interplay between firm behavior, market dynamics, and regulatory environments.

We began by exploring the principles of strategic decision-making, emphasizing the role of rationality, incentives, and interdependence among firms. Game theory provided a structured approach to modeling these interactions, particularly in oligopolistic markets where the actions of one firm significantly impact others. Models such as Cournot, Bertrand, and Stackelberg illustrated how firms compete on quantities and prices, leading to various equilibrium outcomes.

The discussion then extended to supply chain and operational efficiency, highlighting the importance of coordination, information sharing, and process optimization. Theoretical frameworks from operations research and lean management underscored the need for

agility and resilience in supply chains, especially under conditions of uncertainty and disruption.

Finally, we examined the influence of regulatory and environmental considerations on strategic choices. Regulations were shown to alter the strategic landscape by imposing constraints and creating new opportunities for differentiation. Institutional theory provided insights into how firms adapt to and shape these external pressures, integrating compliance into their strategic objectives.

Collectively, these theoretical perspectives offer a robust toolkit for analyzing firm behavior in complex markets. They enable a nuanced understanding of how strategic decisions are formulated in the context of competition, collaboration, and regulation. This foundation sets the stage for the subsequent empirical analysis, where these concepts will be applied to the specific context of the construction industry and its supply chains.

Chapter 2: Industry Analysis: The Market for Concrete and Building Materials

2.1 Market overview and key trends

The second chapter of this thesis transitions from a theoretical framework to an empirical analysis of the construction materials industry, with a particular emphasis on the concrete market. This industry is a fundamental component of modern infrastructure and urban development, serving as a critical input across residential, commercial, and public construction projects. Concrete, as the world's most widely used building material, not only underpins the physical foundations of society but also plays a pivotal role in national economies, labor markets, and regulatory agendas.

Understanding the structure, dynamics, and evolution of this sector requires a nuanced and multi-layered analysis, integrating economic, technological, environmental, and geopolitical considerations. In what follows, the chapter will present a structured exploration of the concrete and building materials industry through a series of interrelated dimensions: the overall market landscape and recent trends; the role of raw material inputs and their price volatility; the influence of technological innovation; the environmental and regulatory challenges facing the sector; and the configuration of competitive forces shaping firm behavior²². This chapter will also lay the empirical groundwork for the case study analysis of Celi Calcestruzzi S.p.A. in Chapter 3.

The market for concrete and building materials represents a cornerstone of the global construction industry and is characterized by its vast scale, regional fragmentation, and complex supply chain dynamics. With global concrete production exceeding 4 billion metric tons annually, the sector exerts a significant influence on industrial output, energy consumption, and carbon emissions. The material's ubiquity is attributed to its versatile properties—mechanical strength, durability, adaptability, and relatively low cost—making it indispensable for infrastructure, housing, and transportation development.

In recent decades, several key trends have redefined the landscape of this industry. First, urbanization and population growth have acted as major demand drivers, particularly in emerging markets across Asia, Latin America, and parts of Africa. Massive infrastructure projects, smart cities initiatives, and urban redevelopment schemes have fueled sustained

consumption of cement and concrete products²³. In contrast, mature markets in Europe and North America have experienced slower growth, with a shift in focus toward renovation, sustainability, and digital integration of construction processes.

Second, supply chain globalization has reshaped production and distribution networks. While concrete itself is often produced and consumed locally due to its perishability and transportation costs, the broader value chain—including cement production, aggregates, additives, and equipment—has become increasingly interconnected through multinational corporations, joint ventures, and cross-border investments. Companies are navigating an environment where logistical efficiency, cost optimization, and local regulatory compliance are critical to maintaining competitiveness.

Third, environmental concerns have emerged as a defining pressure on the industry. Cement production alone accounts for approximately 7–8% of global CO₂ emissions, prompting regulatory bodies, NGOs, and market actors to push for decarbonization and circular economy practices. Innovations such as low-carbon cement alternatives, carbon capture and storage (CCS), and waste-based additives are gaining traction, though widespread adoption remains constrained by technical, financial, and institutional barriers.

Fourth, the industry is undergoing a gradual but profound technological transformation. Digital tools such as Building Information Modeling (BIM), real-time monitoring systems, and predictive maintenance algorithms are increasingly being integrated into production, logistics, and project management. While the sector has historically lagged behind others in terms of digital maturity, competitive pressures and environmental imperatives are accelerating the adoption of Industry 4.0 paradigms.

Lastly, the industry has shown increasing sensitivity to geopolitical instability and macroeconomic volatility. Events such as the COVID-19 pandemic, global supply chain disruptions, energy price shocks, and regional conflicts have exposed the vulnerability of production systems and procurement strategies. As a result, resilience, flexibility, and localization have become core strategic considerations for market players.

In sum, the concrete and building materials market is evolving under the influence of multifaceted trends that encompass demographic, technological, environmental, and

economic dimensions. Understanding these forces is crucial for stakeholders seeking to navigate the strategic complexities of the sector. The following sections will delve deeper into the underlying drivers and implications of these trends, starting with the analysis of raw material availability and cost dynamics.

2.2 Raw material availability and cost fluctuations

The availability and cost of raw materials represent critical determinants of performance and stability in the concrete and building materials industry. As concrete production fundamentally depends on inputs such as cement, aggregates (sand, gravel, and crushed stone), water, and various admixtures, fluctuations in their supply chains can significantly affect production costs, delivery timelines, and strategic planning²⁴.

Cement, the primary binding component of concrete, is both resource- and energy-intensive to produce, requiring substantial amounts of limestone and fossil fuels. Global cement production is concentrated in regions with accessible raw materials and well-developed industrial infrastructure, such as China, India, and Southeast Asia. However, environmental regulations, rising energy prices, and carbon taxation mechanisms are increasingly affecting the cost structures of cement manufacturers worldwide. For instance, the implementation of the European Union Emissions Trading System (EU ETS) has introduced additional financial burdens on clinker production, leading to upward pressure on cement prices.

Aggregates, which typically constitute 60–75% of concrete volume, also face constraints due to extraction limits, transport costs, and regional availability. In many urbanized regions, the depletion of local aggregate sources has led to increased reliance on imports or long-haul transportation, thereby raising costs. Environmental and zoning restrictions further complicate the expansion of quarry operations, tightening supply in critical growth markets. For example, certain countries in Europe and Asia have placed strict limits on river sand extraction due to concerns over ecosystem degradation, pushing the industry toward alternatives such as manufactured sand (M-sand) or recycled aggregates.

Volatility in raw material pricing is exacerbated by macroeconomic factors such as inflation, currency fluctuations, and geopolitical instability. The COVID-19 pandemic

and subsequent disruptions to global logistics chains illustrated how vulnerable the construction materials sector is to supply shocks. According to data from the U.S. Bureau of Labor Statistics and various construction indices, the cost of concrete inputs saw double-digit increases in 2021 and 2022, with some materials like steel and admixtures reaching historically high price levels²⁵. Although prices stabilized somewhat by 2024, supply chain fragility remains a strategic concern.

Moreover, the rising cost of transportation—driven by fluctuating oil prices and regulatory pressures on emissions from freight—further compounds cost variability. Cement and aggregates are inherently heavy and low-value-per-unit materials, making transportation a disproportionately expensive component of their total cost. As such, regional proximity to raw material sources often becomes a decisive factor in competitive positioning within the industry.

In response to these challenges, firms are increasingly adopting risk mitigation strategies such as vertical integration, strategic sourcing, and diversification of supply chains. Investments in local production capabilities, development of recycled alternatives, and long-term contracts with suppliers have emerged as common practices to hedge against price volatility and ensure continuity of supply. In parallel, digital tools for demand forecasting and inventory optimization are gaining traction, enabling firms to better align procurement strategies with market conditions.

In conclusion, raw material availability and cost dynamics are central to the competitiveness and resilience of firms operating in the concrete and building materials industry. As regulatory, environmental, and logistical pressures intensify, managing input risk is becoming a core element of strategic decision-making. The ability to anticipate and adapt to supply chain fluctuations will likely distinguish successful firms in the evolving global construction landscape.

In the Italian market, raw material availability and cost fluctuations in the concrete and construction materials sector are deeply influenced by a combination of geographical

constraints, regulatory frameworks, and structural characteristics of the national economy²⁶. Italy possesses a moderately diversified distribution of raw materials, with significant limestone reserves for cement production located primarily in regions such as Lombardy, Veneto, and Tuscany. However, the national production capacity has been progressively reduced due to declining domestic demand following the 2008 financial crisis and stricter environmental regulations imposed by both national law and EU directives.

Cement production in Italy, once a major pillar of the national construction industry, has undergone significant restructuring. Several plants have been closed or downsized, and the industry has experienced consolidation through mergers and acquisitions. Additionally, Italy's integration within the EU carbon market has exposed domestic producers to the rising cost of emission permits, exacerbating production costs. According to data from AITEC (Associazione Italiana Tecnico Economica del Cemento), the average production cost per ton of clinker has risen steadily, driven not only by energy inputs but also by compliance with environmental monitoring and sustainability protocols.

The situation for aggregates is equally complex. While Italy still maintains operational quarries across various regions, local opposition, bureaucratic inertia, and limitations linked to landscape and heritage protection laws have restricted new quarry openings or expansions. This has led to increased reliance on imports, especially for high-quality aggregates required for specific infrastructural projects. Furthermore, regions such as Emilia-Romagna and Liguria have begun to experiment with recycled aggregates from construction and demolition waste, though these solutions remain marginal in scale and face regulatory uncertainty.

Transport-related cost pressures are particularly acute in Italy due to the country's topography and fragmented logistics infrastructure. The high cost of moving bulk materials through mountainous terrain or congested urban corridors makes proximity to production sites a strategic necessity. In southern regions and on islands such as Sicily

and Sardinia, this challenge is further amplified by limited local supply and higher import dependency, resulting in markedly higher price volatility and logistical constraints.

From a strategic perspective, Italian firms are increasingly seeking to mitigate these risks through vertical integration and digital procurement platforms. Major players are investing in digital solutions for predictive analytics and resource planning to better manage inventory and forecast demand in the face of fluctuating material costs. Furthermore, national and regional incentives supporting the circular economy are promoting innovation in alternative materials and the reuse of industrial byproducts, such as fly ash or slag, in concrete production.

Ultimately, the Italian market reflects broader European trends, but with unique domestic features that amplify sensitivity to raw material shocks. Understanding these localized dynamics is essential for firms operating within or entering the Italian construction ecosystem, as the interplay between regulation, geography, and logistics creates a nuanced landscape of challenges and opportunities.

2.3 Environmental regulations and sustainability challenges

The concrete and construction materials industry faces mounting pressure from environmental regulations and the broader imperative of sustainability, both globally and at national levels. As one of the most resource-intensive and carbon-emitting industrial sectors, concrete production—particularly through its reliance on cement—has become a focal point in climate policy and environmental governance. The calcination process in cement manufacturing alone contributes approximately 7–8% of global CO₂ emissions, prompting regulatory bodies to intensify oversight and demand structural change within the industry²⁷.

Across major markets, including the European Union, North America, and parts of Asia, regulatory frameworks have increasingly targeted greenhouse gas emissions, energy efficiency, and circular economy principles in construction. The EU's Emissions Trading System (ETS) directly affects European cement producers by assigning a cost to carbon output and gradually reducing the number of free allowances available to the sector. Compliance with ETS requirements, alongside national environmental impact assessments and regional building codes, has led companies to invest in mitigation technologies such as carbon capture and storage (CCS), alternative fuels, and clinker substitution with supplementary cementitious materials (SCMs).

Furthermore, sustainability in the concrete value chain involves a multidimensional approach that goes beyond emissions. Water consumption, land use for raw material extraction, biodiversity preservation, and dust pollution are all subjects of regulatory scrutiny. In response, the industry is increasingly shifting toward low-impact production processes, which include the adoption of dry processing methods, energy recovery systems, and more efficient logistics. Companies are also exploring the use of recycled aggregates and industrial byproducts, such as fly ash, silica fume, and slag, which not only reduce environmental burden but can enhance material properties when properly integrated into mix designs.

An important challenge in this transition lies in aligning environmental objectives with economic viability. Many sustainability-enhancing technologies require significant upfront investment, which may not be easily recouped in markets with tight margins and volatile demand. Additionally, differing regulatory intensities across jurisdictions can lead to competitive distortions, where firms operating under stricter regimes face higher compliance costs relative to those in less-regulated environments.

Standard-setting initiatives, such as the European Green Deal, the Cement Sustainability Initiative (CSI), and national green building certifications like LEED and BREEAM, have emerged as critical drivers of change. These frameworks encourage best practices and foster accountability through transparent reporting and performance benchmarking. They also influence procurement processes, particularly for large-scale infrastructure projects, where public tenders increasingly require environmental credentials and life-cycle assessments of materials.

In this evolving context, sustainability is not merely a constraint but a source of strategic differentiation. Companies capable of demonstrating environmental stewardship and adapting to changing regulatory expectations can secure long-term competitive advantages. As observed in Watson's strategic theory, external constraints—such as environmental regulation—alter the payoff structures and feasible strategies available to firms, prompting innovation, repositioning, or collaboration as potential responses to shifting stakeholder expectations.

In sum, the concrete and construction materials industry is undergoing a structural transformation driven by regulatory obligations and societal pressure toward sustainability. Navigating this landscape requires a proactive approach to compliance, innovation, and communication, as environmental performance increasingly becomes a determinant of market access, investor confidence, and corporate legitimacy.

In the Italian context, environmental regulation in the concrete sector is framed by both national legislation and European directives, with particular emphasis on structural integrity, lifecycle performance, and environmental sustainability. One of the most significant regulatory references in Italy is the **Ministerial Decree 17 January 2018**, also known as the “*Norme Tecniche per le Costruzioni*” (NTC 2018), which defines technical requirements for construction materials, including concrete, with regard to mechanical performance, durability, and environmental compatibility. The NTC sets stringent criteria for the classification and certification of concrete compressive strength, mandating systematic testing through standard specimens (typically cylindrical or cubic), and statistical evaluation over production lots to ensure compliance with design specifications. These norms establish the minimum frequency of control and impose traceability obligations on producers to guarantee structural safety across the lifecycle of built infrastructure.

In addition to mechanical standards, the Italian framework also incorporates sustainability criteria via the “**Criteri Ambientali Minimi**” (CAM)—Minimum Environmental Criteria—established under the Ministerial Decree of 11 October 2017 and updated in subsequent revisions²⁸. CAM provisions are mandatory for public procurement and aim to integrate environmental considerations into all stages of construction projects, from design to demolition. For concrete products to comply with CAM, they must demonstrate reduced environmental impact, particularly in terms of embodied carbon and resource consumption. Key requirements include the use of recycled aggregates, the reduction of Portland clinker content through supplementary materials, and the adoption of certified environmental management systems (such as ISO 14001 or EMAS).

Concrete producers that wish to align with CAM standards must also ensure that their mix designs are supported by **Environmental Product Declarations (EPDs)** conforming to ISO 14025 and EN 15804²⁹. These documents provide transparent data on the environmental profile of construction materials, including energy use, global warming potential, acidification, and water footprint. In practice, CAM-compliant cementitious products often include cements with added pozzolanic or slag components (e.g., CEM II/A or CEM III), pre-cast elements produced with recycled content, and ready-mix concrete with certified low-carbon formulations.

²⁸ Ministero dell'Ambiente (2022). *CAM Edilizia – Linee guida operative*.

²⁹ ISO (2015). *Environmental Management Systems – ISO 14001:2015*

Through these instruments, the Italian regulatory framework not only ensures compliance with structural safety but also promotes a progressive alignment of the domestic construction industry with circular economy principles and European sustainability targets. Producers who invest in CAM-compliant processes and materials can enhance their competitiveness in public procurement, reduce regulatory risk, and position themselves as proactive contributors to national decarbonization goals. As sustainability becomes increasingly central to both policy and market dynamics, these regulatory levers serve not only as constraints but as catalysts for innovation and strategic repositioning within the Italian concrete sector.

2.4 Technological Innovation and Digital Transformation

The concrete and broader building materials industry has traditionally been perceived as conservative in adopting new technologies. However, recent years have witnessed a notable acceleration in the integration of digital tools, automation, and data-driven processes, reshaping the industry's operational models and strategic orientation. This transformation is largely driven by the need to enhance productivity, ensure quality control, reduce environmental impact, and respond to growing demand for customization and flexibility in construction projects.

One of the key pillars of innovation in the sector is the implementation of Industry 4.0 technologies, which include the Internet of Things (IoT), advanced sensors, artificial intelligence (AI), machine learning, and cloud-based platforms³⁰. These technologies enable real-time monitoring and control over key production parameters such as mixing ratios, curing temperatures, and moisture levels, which are critical to achieving consistent quality in concrete manufacturing. Smart batching plants and automated delivery systems further streamline logistics and reduce human error, while predictive maintenance systems help minimize downtimes and optimize asset management.

In parallel, Building Information Modeling (BIM) has emerged as a transformative force in the construction value chain. BIM integrates digital representations of physical and functional characteristics of construction components, enabling multidisciplinary teams to collaborate on a shared platform throughout the project lifecycle. In the context of concrete and cement-based materials, BIM facilitates the accurate estimation of material quantities, reduces overproduction and waste, and supports the selection of mix designs that align with structural and environmental specifications. Moreover, BIM's capacity for scenario simulation allows engineers and designers to assess the performance of alternative materials under varying load and climate conditions, contributing to more sustainable and resilient building solutions.

Another important area of technological progress involves material innovation, particularly in the development of high-performance and sustainable concretes. These include ultra-high-performance concrete (UHPC), fiber-reinforced concrete, self-healing

concrete, and mixes incorporating recycled or bio-based aggregates. Advances in admixture chemistry also play a pivotal role, enabling the optimization of workability, setting time, and durability without compromising compressive strength. Such innovations are increasingly supported by computational mix design platforms that use algorithms to identify optimal compositions based on cost, performance, and environmental criteria.

Furthermore, 3D concrete printing (3DCP) is gaining traction as a disruptive technology with the potential to revolutionize construction methods. This additive manufacturing approach allows for the direct extrusion of concrete layers based on digital models, eliminating the need for formwork, reducing material usage, and enabling complex geometries that would be difficult or expensive to achieve using traditional techniques. Although still in its early stages of adoption, especially for structural elements, 3DCP demonstrates how digital and physical technologies can converge to enhance productivity and design freedom.

In the Italian market, the pace of digital transformation is more gradual but increasingly aligned with European trends. Many producers are adopting digital quality control systems and integrating ERP (Enterprise Resource Planning) platforms with production and logistics functions. Additionally, national and regional incentives—such as those under the Piano Nazionale Transizione 4.0—encourage investments in advanced machinery, software, and training, fostering a more innovation-driven mindset across the industry. Collaborative research initiatives and pilot projects, often involving universities, consortia, and public entities, are also instrumental in bridging the gap between technological potential and commercial application.

In conclusion, technological innovation and digital transformation are redefining competitive advantage in the concrete industry. Companies that effectively harness these tools can improve operational efficiency, adapt to evolving regulatory and environmental demands, and offer more tailored and sustainable solutions to clients. As the market becomes more complex and interconnected, digitalization is no longer optional but a strategic imperative for resilience and long-term growth.

2.5 Competitive landscape and strategic positioning

The competitive dynamics within the concrete and building materials industry are shaped by a combination of structural characteristics, market entry barriers, pricing behaviors, and strategic differentiation. Unlike industries characterized by rapid technological obsolescence or high brand loyalty, the concrete sector tends to exhibit features of oligopolistic competition, where a limited number of key players hold significant market shares, and rivalry is often based on operational efficiency, geographic proximity, reliability, and compliance with regulatory and sustainability standards.

One of the primary forces governing competition in this industry is the local nature of concrete production and distribution. Due to its high weight-to-value ratio and perishability—concrete must be poured within a short window from production—firms typically operate within localized markets anchored by batching plants strategically located near construction hubs. This geographic segmentation means that market concentration and competitive intensity can vary significantly across regions, even within a single country. In dense urban areas with multiple producers, competition tends to be price-driven, while in more peripheral or infrastructure-intensive zones, firms can leverage long-term contracts and logistics advantages to secure a stable client base.

Strategic positioning within this landscape hinges on several key levers. First, cost leadership remains a dominant strategy, especially among large vertically integrated firms that control the upstream supply of aggregates and cement. These players can exploit economies of scale, optimize logistics, and invest in process automation to reduce unit costs and buffer price volatility. Conversely, differentiation strategies are pursued by firms that emphasize product quality, innovation (e.g., specialty concretes), technical support, and sustainable solutions. Differentiation also extends to service dimensions, such as flexibility in delivery scheduling, digital ordering platforms, and real-time tracking capabilities—features increasingly valued by construction companies operating under tight project timelines³¹.

Another dimension of competitive positioning involves strategic alliances and consortia, particularly in the context of public procurement or large-scale infrastructure projects.

Firms may collaborate to pool resources, share technical expertise, or meet the qualification thresholds required by institutional clients. Such arrangements can also mitigate risk and enhance bargaining power vis-à-vis suppliers and clients, although they may raise concerns under competition law depending on their structure and market impact.

Barriers to entry play a critical role in maintaining the incumbent firms' strategic advantage. These include not only capital intensity and regulatory compliance costs—especially in terms of environmental standards and safety certifications—but also reputational capital and longstanding client relationships. For newcomers, penetrating the market requires not only competitive pricing but also the ability to demonstrate reliability and compliance with technical specifications such as structural resistance classifications, durability metrics, and, where applicable, CAM (Criteri Ambientali Minimi) certifications.

In the Italian context, the competitive environment reflects a fragmented structure with a coexistence of large multinational groups, regional champions, and small-to-medium enterprises (SMEs). While global players benefit from integration and investment capabilities, local firms often compete on relational proximity and responsiveness to specific client needs. The increasing role of green procurement and sustainability certifications is also influencing strategic positioning: firms able to document lower carbon footprints, recycled content, or compliance with environmental regulations are gaining preferential access to both public and private tenders.

Moreover, digital transformation and the integration of environmental, social, and governance (ESG) criteria are emerging as key differentiators. Companies that invest in traceability systems, transparent reporting, and lifecycle analysis tools are not only improving operational efficiency but also aligning their strategic identity with evolving stakeholder expectations. In doing so, they enhance their attractiveness to investors, clients, and regulators in an industry traditionally dominated by volume-driven competition.

Ultimately, the concrete industry's competitive landscape demands a careful balancing act between efficiency, compliance, innovation, and market responsiveness. Strategic positioning is not solely a function of price but of the firm's capacity to embed value

across its supply chain, ensure regulatory alignment, and anticipate structural changes—such as shifts in demand, input cost variability, and tightening environmental constraints. As subsequent chapters will show, these dynamics are particularly salient in the context of the Italian market, where firms must navigate both global competitive pressures and domestic regulatory particularities.

Among the leading players shaping the global and European concrete market, Heidelberg Materials (formerly HeidelbergCement), Holcim Group, Buzzi Unicem, Cemex, and Italcementi represent dominant actors with vertically integrated operations encompassing cement, aggregates, ready-mix concrete, and related building materials³². These multinational corporations possess substantial market power, derived not only from their production scale and geographic footprint but also from their technological capabilities, brand reputation, and ability to influence industry standards.

In Italy, the competitive landscape features a nuanced coexistence of these international conglomerates with regional and national firms such as Colabeton, Calcestruzzi S.p.A. (a subsidiary of Italcementi), Unical AG (linked to Buzzi Unicem), and a multitude of small and medium-sized enterprises (SMEs) specialized in ready-mix and precast concrete³³. The market structure in Italy is characterized by geographical fragmentation, often influenced by logistical constraints and the localized nature of demand in the construction sector.

The strategic behavior of these firms is influenced by multiple factors, including public infrastructure investments, fluctuations in private construction activity, and regulatory developments tied to sustainability and environmental compliance. For instance, larger firms often position themselves advantageously in public tenders through certifications aligned with CAM requirements and robust ESG practices, while also investing in low-carbon technologies and recycled aggregates. In contrast, SMEs typically rely on customer proximity, personalized service, and operational flexibility as competitive levers.

Market dynamics are also shaped by periodic cycles of consolidation and divestiture, whereby large corporations optimize their portfolios by acquiring local producers or exiting non-strategic markets. This process contributes to the continuous redefinition of competitive boundaries and may also trigger regulatory scrutiny under antitrust laws.

³² Statista (2023). *Leading Concrete and Cement Producers in Europe*.

³³ Statista (2023). *Leading Concrete and Cement Producers in Europe*.

In sum, the presence and strategic positioning of key industry players contribute significantly to shaping the competitive logic of the concrete market. Their ability to respond to structural trends—such as green transition policies, digital innovation, and supply chain integration—will continue to determine the future contours of competition within this essential sector of the construction industry.

The analysis conducted throughout this chapter has provided a comprehensive overview of the concrete and building materials industry, highlighting both its structural foundations and dynamic challenges. Beginning with an exploration of market trends—such as urbanization, infrastructure renewal, and environmental imperatives—the chapter examined the macro and microeconomic forces influencing the sector’s evolution. Special attention was given to the volatility of raw material costs, the availability of key inputs, and the exposure of the industry to geopolitical disruptions and energy price fluctuations.

In regulatory terms, the concrete sector finds itself increasingly conditioned by evolving environmental standards and sustainability expectations. International initiatives, such as the European Green Deal, as well as national regulations like the Italian CAM (Criteri Ambientali Minimi), are pushing firms to reassess their operational and product strategies in light of climate targets and circular economy principles. In this context, certifications, performance-based standards, and resistance testing protocols are not merely technical obligations but crucial levers of market competitiveness and institutional legitimacy.

Furthermore, the chapter delved into the structure and behavior of key actors operating in this competitive environment, underscoring the role of major multinational groups alongside domestic SMEs. Strategic positioning, supply chain control, innovation capacity, and regulatory alignment emerged as fundamental factors differentiating market leaders from followers.

Overall, the concrete industry—while mature and historically rooted—stands at a critical juncture. Pressures for decarbonization, the need for digital integration, and shifting construction demands are transforming the traditional paradigms of production and competition. The findings of this chapter lay the empirical and contextual groundwork for the subsequent strategic analysis, where theoretical tools will be applied to assess firm behavior, industry interactions, and the long-term viability of different competitive approaches in this evolving landscape.

Chapter 3: Case Study – Celi Calcestruzzi S.p.A.

3.1 Company background and market positioning

This chapter introduces Celi Calcestruzzi S.p.A., a prominent Italian company in the concrete and construction materials sector. The aim is to analyze the company's market positioning, historical development, and its role within the national competitive landscape, with particular attention to market dynamics and challenges related to sustainability and innovation.

Celi Calcestruzzi S.p.A. was established in 1982, building upon the post-World War II efforts of Salvatore Celi, who initiated the extraction and processing of aggregates to aid in Italy's reconstruction. Over the years, the company has expanded its operations beyond aggregate processing to include the production of concrete, bituminous conglomerates, prefabricated elements, and premixed products. Its facilities are strategically located in the Abruzzo and Lazio regions, including sites in Magliano dei Marsi, Massa D'Albe, Civita di Oricola, Bazzano, and Vazia .³⁴

The company's market positioning is reinforced by its comprehensive service offerings, which encompass industrial construction, primary urbanization, earthworks, aqueducts, sewage systems, road construction, and paving. Additionally, Celi Calcestruzzi produces a range of prefabricated components, such as slabs, beams, and reinforced concrete elements, further solidifying its status as a versatile supplier in the construction industry .

Celi Calcestruzzi's commitment to quality and innovation has been recognized through multiple accolades. Notably, the company has been awarded the Industria Felix Prize for three consecutive years, acknowledging its excellence in management performance and financial reliability.³⁵ Such recognition underscores the company's dedication to sustainable practices and technological advancement in its operations.

In recent years, Celi Calcestruzzi has embraced circular economy principles by initiating the recovery of ferrous and non-ferrous materials. The establishment of the CeliFer facility in Avezzano exemplifies this commitment, enabling the recycling of construction waste into new building materials . This initiative not only contributes to environmental

³⁴ Celi Calcestruzzi S.p.A. (2023). *Company History*. www.celicalcestruzzi.it

³⁵ Industria Felix Magazine (2023). *Le aziende premiate per la performance gestionale in Abruzzo e Lazio*. www.industriafelix.it

sustainability but also enhances the company's service offerings to clients seeking eco-friendly construction solutions.

Overall, Celi Calcestruzzi S.p.A. exemplifies a successful integration of traditional values with modern innovation, positioning itself as a leader in Italy's construction materials sector. Its strategic expansion, commitment to sustainability, and recognition for excellence reflect a robust and adaptive business model poised for continued growth in the evolving construction industry.

3.2 Strategic decisions and competitive strategies

Celi Calcestruzzi S.p.A. has developed its strategic direction around a set of guiding principles that combine entrepreneurial pragmatism with long-term investment in innovation, diversification, and operational autonomy. The company's vision for growth is grounded in an understanding of the evolving dynamics of the construction industry and a clear intent to expand its market presence while maintaining control over the quality and flexibility that distinguish its brand.

At the core of Celi Calcestruzzi's strategic plan is the continuous expansion of its range of products and services. The company seeks to position itself not merely as a supplier of concrete, but as a comprehensive provider of integrated construction materials and services. This includes a deliberate investment in new technologies, expanded production capacity, and diversification into complementary sectors such as asphalt, prefabricated components, excavation and earthmoving, and secondary material recovery. Recent years have seen the company extend its operational footprint, with the opening of two new concrete plants between 2024 and 2025, part of a broader strategy aimed at following market trends and capturing emerging demand in adjacent geographic regions.

Strategic decisions are coordinated through a centralized governance structure led by Gianfranco and Sergio Celi, whose hands-on leadership ensures both strategic alignment and rapid operational responsiveness³⁶. While top-level decisions are made at the ownership level, the company delegates execution to plant directors and functional heads responsible for technical, administrative, legal, and commercial operations. This balance between centralized strategic vision and decentralized implementation allows for operational flexibility across the company's various units—including Celifer, CeliPrem, CeliCalcestruzzi, CeliAsfalti, CeliLavorazioni, CeliInerti, and CeliPrefabbricati. Each of these divisions, while aligned with group-level priorities, maintains autonomy over pricing strategies, financial planning, and operational focus, reflecting the specificity of their respective markets and product lines.

In terms of competitive strategy, Celi Calcestruzzi adopts a hybrid approach, simultaneously pursuing cost leadership, differentiation, and niche specialization. While price remains a decisive factor in many procurement processes—particularly in public tenders—the company deliberately invests in product and service differentiation. It emphasizes quality, punctuality, responsiveness, and tailored technical solutions that add value beyond the basic product offering. Its vertically integrated structure, with internal control over raw material sourcing, production, and logistics, enables efficiency and cost control, but also grants strategic agility and customer intimacy that large multinational competitors often lack. This lean and direct chain of command allows clients to interact closely with decision-makers, creating a sense of transparency and trust.

A defining feature of the company's strategic positioning is its commitment to sustainability and regulatory alignment. Celi Calcestruzzi invests heavily in environmental compliance and actively supports Italy's transition toward circular construction. Its adherence to CAM (Criteri Ambientali Minimi) standards, along with its investment in recycled materials and energy-efficient machinery, positions it as a forward-thinking player attuned to contemporary regulatory and societal expectations. This approach not only ensures eligibility for public contracts but also enhances the company's brand reputation in an increasingly ESG-driven market environment.

The company's client base is broad and diversified, encompassing public authorities, private developers, large general contractors, and industrial consortia. This diversification reduces dependence on any single market segment and ensures resilience against sector-specific downturns. Furthermore, long-term relationships and repeat business, particularly in infrastructure and urban development projects, form a stable core of the company's revenue stream.

Celi Calcestruzzi's financial performance reinforces the effectiveness of its strategic choices. For the past 15 years, the company has reported continuous growth in revenue, culminating in a turnover of €49 million in 2024. In addition to top-line expansion, the

company has demonstrated sound financial management across multiple indicators—earning it the prestigious Industria Felix award for four consecutive years. These recognitions reflect not only financial solidity but also strategic clarity and managerial excellence.

In conclusion, Celi Calcestruzzi S.p.A.'s competitive strategy is rooted in a multi-dimensional model that leverages local embeddedness, vertical integration, service diversity, and sustainable innovation. The company's forward-looking investments, combined with centralized leadership and adaptive operations, ensure it remains well-positioned to compete effectively in both regional and national markets, while aligning itself with the long-term transformations of the construction industry.

3.3 Pricing strategies and cost structures

Celi Calcestruzzi S.p.A. adopts a flexible and highly contextualized pricing strategy in the concrete sector, guided by an operational model that closely reflects the characteristics of local market competition and the logistical, technical, and economic variability of each individual project. The company does not rely on standardized price lists for its ready-mix concrete; instead, prices are defined dynamically based on the actual cost of production inputs, the specific services required by each client, the logistical context of each site, and broader trends in competitor behavior. This approach allows the firm to tailor its pricing to each negotiation, maximizing competitiveness while preserving margin integrity.

The core pricing mechanism for concrete products is cost-based. Prices are calculated starting from a detailed estimation of direct production costs, including the cost of aggregates, cement, additives, plant operations, and labor. To this base cost, the company adds a transportation component, which is determined according to the distance from the nearest plant to the job site. A theoretical profit margin—typically between 5% and 10%—is then applied, although in highly competitive or large-scale projects, this margin may be strategically reduced to ensure contract acquisition. Notably, the price of cement represents the most volatile and impactful component of the cost structure due to its high sensitivity to energy markets and regulatory burdens, including those related to emissions trading schemes and decarbonization policies.

Celi Calcestruzzi's pricing is also influenced by client segmentation and relationship history. Long-standing clients, those with high-volume orders, or those involved in large-scale infrastructure projects are often granted preferential pricing conditions. This loyalty- and volume-based pricing reflects the firm's recognition of the strategic value of stable, long-term commercial relationships and the operational advantages of securing high-output contracts. In contrast, smaller, low-frequency clients may be offered higher per-unit prices to reflect the reduced economies of scale and higher relative delivery costs.

The company operates in a highly localized and fragmented market, where price competition is intense and strongly influenced by the behavior of nearby competitors. In many cases, pricing decisions are not solely the result of internal calculations but are reactive to the evolving strategies of rival firms within a 30–40 km radius. The structure of the market often creates a downward pressure on prices, as companies engage in aggressive bidding to secure contracts. This phenomenon resembles a form of price-led tacit competition, where the actions of one player can trigger a cascading adjustment in market prices across multiple firms—gradually eroding theoretical margins in pursuit of volume and market share.

Celi's cost structure reflects a typical composition for vertically integrated concrete producers. The main cost drivers include raw materials (cement and aggregates), labor, plant maintenance, energy, transportation logistics, depreciation of machinery, and environmental compliance. Among these, the cost of cement remains the most volatile and significant, while transportation costs are a close second, especially given the necessity for timely delivery and the weight-intensive nature of the product. Fixed costs, such as facility depreciation and salaried labor, represent a relatively large portion of the overall cost structure, reinforcing the importance of maximizing plant utilization to maintain profitability.

Plant operations are managed in a demand-driven model, where production levels fluctuate according to the volume and timing of project acquisition. Plants do not operate continuously at full capacity, but adjust their output based on client requirements and secured contracts. This structure introduces a variable workload for the production system, making commercial strategies and pricing flexibility essential tools for maintaining consistent utilization and minimizing idle capacity. In this context, successful bidding and pricing strategies are directly tied to the efficiency and sustainability of plant operations.

Digitalization plays an increasingly important role in optimizing cost management and resource allocation. The company employs digital tools to monitor production inputs, schedule deliveries, and reduce material waste—thus enhancing cost control and enabling real-time adjustments to maintain target profit margins. The integration of production planning software and ERP systems supports more accurate forecasting and responsiveness to demand fluctuations, contributing to the firm’s overall financial performance.

Celi Calcestruzzi also offers concrete products certified to meet environmental criteria such as the Italian CAM (Criteri Ambientali Minimi), which are priced at a premium due to their higher production costs. These sustainable concretes, which may incorporate recycled aggregates, low-clinker cement types, or additives derived from industrial byproducts, require stricter quality control and traceability. Nonetheless, there is a growing segment of the market—particularly in public procurement—that is willing to accept the price differential in exchange for compliance and environmental performance. In this way, environmental differentiation becomes not only a regulatory requirement but also a strategic pricing lever.

The company’s ability to navigate inflationary pressures has also been tested in recent years, particularly during the 2021–2022 period marked by global energy crises and logistics disruptions. In this context, Celi opted for a balanced response: while in some cases price increases were necessary and passed on to clients, in others the company absorbed part of the cost escalation to preserve client loyalty and ensure continuity of relationships. This selective absorption strategy was made possible by operational efficiencies and the firm’s capacity to maintain tight control over indirect costs, thereby preserving margins even in volatile environments.

In conclusion, the pricing and cost management strategies of Celi Calcestruzzi S.p.A. demonstrate a sophisticated balance between responsiveness to market pressures and the safeguarding of long-term profitability. Through dynamic pricing, lean operations,

technological integration, and environmental differentiation, the company sustains its competitive position in a market characterized by commoditization, regional competition, and increasing regulatory expectations. This nuanced approach to pricing is not only a tactical instrument but a reflection of the company's broader strategic posture in the contemporary concrete industry.

3.4 Adaptation to environmental, regulatory, innovations and future challenges

Celi Calcestruzzi S.p.A. has demonstrated a deliberate and strategic commitment to aligning its operations with contemporary environmental standards, emerging regulatory frameworks, and the accelerating pace of technological innovation. In doing so, the company not only ensures compliance with present-day requirements but positions itself proactively to face the structural shifts anticipated within the concrete industry over the next decade. The firm's adaptation strategy encompasses four tightly interrelated domains: environmental sustainability, regulatory compliance, innovation and digitalization, and future-readiness.

From an environmental standpoint, the company has made substantial investments in circular economy principles, integrating recycling practices into its core production processes. Celi Calcestruzzi utilizes secondary raw materials derived from processed construction waste, including inert aggregates and ferrous components, thus reducing the demand for virgin materials and the environmental footprint of its operations. In parallel, the firm has modernized its fleet and production facilities, progressively introducing hybrid and electric-powered machinery and vehicles wherever feasible. These investments serve the dual function of reducing greenhouse gas emissions and improving operational efficiency, thereby embedding sustainability into the company's industrial infrastructure.

Energy transition is another focal point of Celi Calcestruzzi's green strategy. The company has been actively investing in renewable energy solutions for over a decade, integrating photovoltaic systems and other low-emission energy sources into its operational model. This long-term commitment not only mitigates exposure to fossil fuel volatility but also reflects a broader organizational ethos that views environmental sustainability not as a constraint, but as a competitive opportunity. The firm's environmental credentials are substantiated through formal certifications, including ISO 14001 for environmental management systems and compliance with CAM (Criteri Ambientali Minimi), positioning the company as a credible and qualified supplier in public procurement procedures where sustainability performance is increasingly decisive.

In the regulatory sphere, Celi Calcestruzzi has adopted a proactive and anticipatory posture. The company maintains an internal technical, legal, and environmental compliance office that continuously monitors the evolution of relevant legislation—both at the national and European levels—and ensures timely implementation of required adjustments. This institutional capability enables the firm to respond swiftly to regulatory changes, such as the gradual tightening of CO₂ emissions thresholds under the European Union’s Green Deal and Emissions Trading Scheme (ETS)³⁷, or updates to regional building codes and procurement criteria. Importantly, the company invests regularly in training and upskilling programs to ensure that both managerial and operational staff remain informed and capable of operating within an increasingly regulated industry.

This regulatory readiness directly supports the firm’s participation in public tenders and infrastructure projects, many of which impose stringent environmental and technical criteria as a prerequisite for eligibility. Celi Calcestruzzi not only meets these standards but often outperforms competitors in terms of environmental documentation, sustainability metrics, and technical responsiveness. These capabilities have allowed the company to consolidate its position in strategic market segments where compliance is not only required but also valued as a sign of long-term reliability and institutional trustworthiness.

Technological innovation represents a third strategic pillar in the company’s adaptation framework. Celi Calcestruzzi has adopted a suite of advanced tools—including enterprise resource planning (ERP) systems, automated batching plants, and sensor-based quality control technologies—that enhance production accuracy, reduce waste, and streamline operations. These systems contribute to the overall resilience and responsiveness of the firm’s logistical and production processes. In addition, the company integrates Building Information Modeling (BIM) technologies and digital material tracking platforms into its client-facing operations, enabling real-time coordination, transparency, and traceability across project lifecycles.

The company has also internalized innovation as an organizational function. Dedicated personnel are tasked with overseeing technological upgrades, implementing digital strategies, and scouting for emerging tools that could enhance competitiveness. This forward-looking orientation facilitates not only operational efficiency but also the

development of new value-added services, further distinguishing the firm from less agile competitors. Innovation is thus not a reactive response to market changes, but an embedded capacity that supports sustained adaptability.

Looking toward the future, Celi Calcestruzzi acknowledges a series of structural challenges that will shape the construction and concrete sectors in the coming years. Among these, the company identifies the increasing scarcity and rising cost of raw materials, the growing stringency of environmental and safety regulations, the emergence of novel construction techniques and alternative materials, and a general contraction in the volume of public and private construction activity. These pressures necessitate a rethinking of conventional business models and a move toward greater agility, resource efficiency, and strategic foresight.

In anticipation of these shifts, Celi Calcestruzzi has already begun to implement strategic countermeasures. These include the diversification of material inputs, exploration of alternative binders, enhancement of plant flexibility, and strengthening of relationships with public authorities and research institutions. The company is actively engaged in experimental projects and partnerships with universities and innovation consortia, reflecting its desire to remain at the forefront of technological and ecological transition within the sector. These collaborations not only enrich the firm's technical know-how but also facilitate access to cutting-edge insights and potential funding mechanisms for applied research and development.

In conclusion, Celi Calcestruzzi's multidimensional adaptation strategy exemplifies a comprehensive and integrated approach to managing transformation. By embedding environmental responsibility, regulatory compliance, technological innovation, and future-oriented planning into its core business practices, the company affirms its resilience in the face of uncertainty and its leadership in a sector undergoing fundamental change. Rather than perceiving change as a threat, the firm has embraced it as an opportunity to refine its capabilities, redefine its role, and reinforce its commitment to sustainable value creation in the construction materials industry.

3.5 Strategic Analysis through Porter's Five Forces and Game Theory

The competitive environment in which Celi Calcestruzzi S.p.A. operates can be effectively understood through the application of two fundamental strategic frameworks: Porter's Five Forces and Game Theory. These models, examined in detail in Chapter 1, allow for a structured assessment of the external pressures and interactive dynamics that shape strategic behavior in the concrete industry. By combining structural analysis with interactive reasoning, this section provides a nuanced interpretation of how Celi Calcestruzzi navigates its competitive context and positions itself for long-term success.

From the perspective of Porter's Five Forces, the first dimension to consider is the threat of new entrants. The concrete industry is characterized by significant entry barriers, particularly in terms of capital investment, regulatory compliance, and economies of scale. Celi Calcestruzzi benefits from high plant efficiency, a vertically integrated supply chain, and long-standing relationships with both public and private clients. Furthermore, the company's compliance with environmental certifications such as ISO 14001 and CAM enhances its eligibility for public tenders—an area where regulatory and technical requirements deter less experienced entrants. The presence of localized production systems and logistical constraints further limits the feasibility of new competitors entering the same regional markets where Celi has a consolidated presence.

The bargaining power of suppliers in this context is moderate to high, especially regarding critical inputs like cement, which is both price-volatile and energy-intensive. However, Celi's internal control over aggregates and its investment in circular sourcing practices mitigate some of this exposure. Vertical integration with subsidiaries operating in raw material extraction, recycling, and transport gives the company strategic flexibility and cost leverage that many competitors lack.

The bargaining power of buyers, on the other hand, is a more pressing force. In a commoditized market like concrete, especially in regions where price sensitivity dominates procurement decisions, customers wield considerable influence. Celi Calcestruzzi addresses this pressure through service differentiation, relationship management, and flexible pricing structures that account for distance, volume, and

technical specifications. Long-term clients and public entities value not only price competitiveness but also reliability, regulatory compliance, and environmental performance—factors that allow the company to defend its margins despite the prevalence of price-based competition.

The threat of substitutes is relatively low in the core concrete segment, given its unique structural properties and widespread use. However, emerging technologies and materials—such as engineered timber or geopolymer concretes—may represent longer-term substitution threats, particularly in sustainability-sensitive projects. Celi's investment in product innovation and its openness to experimental materials help mitigate this risk and position the firm as an early mover in the evolving construction ecosystem.

Competitive rivalry, the final force, is undoubtedly the most intense and dynamic in Celi Calcestruzzi's strategic landscape. As described in Chapter 2, the company operates within a fragmented and regionally constrained market, where direct competitors act within a 30–40 km radius and often engage in aggressive price competition to secure projects. This behavior mirrors the theoretical model of Bertrand competition, where firms with similar cost structures reduce prices until profits approach zero. In such an environment, the strategic response must extend beyond price; Celi differentiates itself through integrated service offerings, quality assurance, technical consultancy, and environmental certifications.

To further understand the company's strategic behavior, Game Theory provides a complementary lens. As outlined in Chapter 1, the interdependence among market actors and the repeated nature of their interactions suggest the relevance of repeated games and mixed strategies. For example, in the context of public tenders or large private contracts, Celi's decision to maintain stable prices or offer incremental discounts is influenced by expectations about competitors' behavior and reputational considerations. By avoiding excessive underbidding, the firm may preserve industry norms and signal a commitment to long-term collaboration, rather than initiating destructive price wars.

Moreover, the company's approach to environmental compliance and innovation can be seen as a strategic signal within a Bayesian game framework, where clients infer the firm's "type" (e.g., high-quality, compliant, forward-looking) from its observable behavior—such as certifications, investment in technology, and sustainability reporting.

These actions function as credible commitments that differentiate Celi from less structured or less compliant firms.

In oligopolistic settings, strategic commitments such as investment in infrastructure, capacity expansion, or partnerships can also alter the game structure by shaping rivals' expectations and constraining their future options. Celi's expansion with two new plants between 2024 and 2025 is a prime example of such a commitment. It increases the company's market coverage, signals long-term operational stability, and may deter competitors from entering or intensifying efforts in adjacent markets.

Finally, coordination games are also relevant in public-private partnerships and large-scale projects where multiple stakeholders must align on technical standards, environmental requirements, and delivery timelines. Celi's proven ability to coordinate with municipalities, consortia, and general contractors increases its attractiveness as a reliable partner in such multi-agent environments.

In conclusion, the strategic landscape of Celi Calcestruzzi S.p.A. can be effectively interpreted through the dual lenses of Porter's Five Forces and Game Theory. While Porter's model offers insight into the structural pressures faced by the firm, Game Theory provides a dynamic framework for understanding strategic interactions and the logic behind decision-making in a competitive and interdependent environment. The company's ability to manage rivalry, leverage internal resources, and communicate long-term credibility allows it to maintain a differentiated and resilient position in a sector that is both structurally challenging and rapidly evolving.

Chapter 3 has offered an in-depth empirical investigation of Celi Calcestruzzi S.p.A., a medium-large Italian enterprise operating in the concrete and construction materials sector. Through a structured case study approach, the chapter has applied the theoretical insights developed in Chapter 1—especially those concerning strategic decision-making, competitive forces, game-theoretic logic, and organizational adaptation—to the real-world context of a firm facing the multifaceted challenges and opportunities of a mature but evolving industry.

The first section examined the company's background and market positioning, highlighting Celi's long-standing presence in the Italian construction landscape and its gradual evolution from a regional aggregates supplier to a vertically integrated, multi-division group offering a wide spectrum of construction-related products and services. With operational sites across Abruzzo and Lazio and a diversified portfolio that includes concrete, asphalt, prefabricated elements, and earthworks, the company has strategically positioned itself as a full-service provider capable of responding to a broad range of client needs. Its consistent financial growth—capped by a €49 million turnover in 2024—combined with awards for managerial excellence, attests to its robust organizational and commercial foundations.

In terms of strategic decisions and competitive behavior, the firm exemplifies a hybrid approach, combining cost leadership with service differentiation and environmental innovation. Guided by a centralized but responsive decision-making structure, Celi Calcestruzzi's leadership has pursued expansion not only through capital investment—such as the recent opening of two new plants—but also through the internal development of specialized divisions (e.g., Celifer, Celiprefabbricati, CeliAsfalti). Each business unit operates with a degree of autonomy, enabling localized strategic flexibility within a unified corporate vision. This multi-unit governance model allows the company to tailor pricing, operations, and marketing to different segments while preserving strategic coherence.

The analysis of pricing strategies and cost structures offered a concrete application of managerial cost analysis principles. Pricing is derived from a real-time evaluation of direct production costs—including raw materials, plant operations, transportation, and labor—along with a dynamic margin calibrated according to market conditions. The absence of standardized price lists in favor of negotiated, project-specific pricing reflects the firm's adaptation to a competitive environment characterized by localized oligopoly and Bertrand-like price competition. In this context, long-term client relationships, logistical proximity, and service customization function as critical levers to sustain margins and secure continuous plant utilization.

A key pillar of the firm's long-term strategy is its adaptation to environmental and regulatory pressures, especially those linked to Italy's increasing alignment with European decarbonization targets and sustainability frameworks. Celi Calcestruzzi has proactively invested in green infrastructure, including hybrid/electric fleets, recycling systems, and renewable energy, while maintaining full compliance with standards such as CAM and ISO 14001. The presence of an in-house technical and environmental compliance team allows for agile and timely responses to evolving regulatory requirements, enhancing the company's competitiveness in public tenders and its reputation among environmentally conscious stakeholders.

From an innovation and digital transformation perspective, Celi Calcestruzzi has adopted a forward-looking posture. The integration of ERP systems, automated batching plants, and sensor-based monitoring supports cost efficiency, quality control, and just-in-time responsiveness. The use of Building Information Modeling (BIM) and digital logistics tools enhances client communication and project coordination, while internal structures dedicated to innovation ensure ongoing technological renewal and organizational learning. These practices not only improve operational efficiency but also strengthen the firm's ability to respond to disruptive change and resource constraints.

The final section applied Porter's Five Forces and Game Theory to analyze Celi Calcestruzzi's strategic environment. Porter's model illuminated the structural dimensions of competition—entry barriers, supplier and buyer power, substitution threats, and industry rivalry—while game-theoretic tools provided insight into the strategic behavior of firms in a repeated and interdependent market. Concepts such as signaling, strategic commitment, and mixed strategies help explain how Celi balances aggressive pricing pressures with reputational management and long-term relationship-building. The firm's emphasis on stability, transparency, and sustainability operates not only as a competitive advantage but also as a rational strategy within a dynamic and interactive market context.

In synthesis, Chapter 3 has demonstrated that Celi Calcestruzzi S.p.A. operates with a high degree of strategic coherence, adaptive capacity, and organizational depth. Its case provides a real-world illustration of how firms in traditional sectors such as construction materials can thrive by integrating economic logic with environmental responsibility and innovation-driven flexibility. The insights derived from this case will serve as a basis for the next chapter, where broader theoretical implications, strategic recommendations, and industry-wide reflections will be developed.

Chapter 4: Discussion and Implications

4.1 Key findings from industry analysis and case study

This chapter aims to synthesize the theoretical, empirical, and strategic insights developed in the previous chapters and to interpret them through the lens of managerial decision-making in the context of the concrete and construction materials industry. Building on the conceptual framework presented in Chapter 1, the industry-wide dynamics examined in Chapter 2, and the in-depth case study of Celi Calcestruzzi S.p.A. in Chapter 3, this chapter focuses on the broader implications of strategic choices in environments characterized by structural constraints, regulatory pressure, environmental imperatives, and technological transformation.

The discussion begins with a reflection on the applicability and explanatory power of managerial decision-making theories in the context of a mid-sized industrial firm operating in a semi-commoditized and geographically fragmented market. Special attention will be given to how rational decision models, bounded rationality, and strategic reasoning frameworks—such as game theory—align with the real-world behaviors observed in Celi Calcestruzzi’s approach to pricing, competitive positioning, investment, and regulatory adaptation.

The second section addresses the integration of sustainability into corporate strategy, emphasizing how firms in resource-intensive sectors are redefining their competitive logic in response to environmental challenges. Drawing on empirical findings, the chapter will explore the role of certifications, circular economy practices, and green product development as strategic differentiators. The goal is to critically assess whether sustainability is internalized as a core value or managed as an external compliance factor.

The third area of discussion concerns the implications of competitive dynamics and industry structure, as modeled through Porter’s Five Forces and game-theoretic logic. This section will interpret how price-based competition, oligopolistic rivalry, and entry barriers shape the strategic calculus of firms, and how interfirm behavior in local markets

generates systemic outcomes that influence pricing trends, investment incentives, and long-term viability.

In the fourth section, the chapter explores the strategic role of innovation and digital transformation, identifying both opportunities and constraints for firms attempting to modernize their operations and align with Industry 4.0 paradigms. The analysis will consider how internal capabilities, organizational learning, and cross-functional coordination affect the adoption of technologies such as automation, BIM, and digital logistics in traditional industrial settings.

Finally, the chapter concludes by extracting a series of managerial implications and recommendations for firms operating in the concrete and construction materials sector. These reflections are intended to inform both practitioners and policymakers, offering strategic guidance grounded in theoretical reasoning and empirical observation. The discussion will also acknowledge the limitations of the study and suggest directions for future research, especially in light of the ongoing transformations affecting supply chains, labor markets, environmental policy, and technological innovation in the construction ecosystem.

In sum, Chapter 4 acts as a platform for critical integration, moving from description to interpretation, and from analysis to recommendation. It reinforces the central thesis that effective managerial decision-making—especially under uncertainty—requires not only technical competence and cost control, but also strategic vision, adaptive capacity, and the willingness to engage with the structural and environmental realities of the industry.

The analysis developed in the preceding chapters has revealed a set of interconnected findings that illuminate the strategic and operational dynamics of the concrete and construction materials industry, with specific reference to the case of Celi Calcestruzzi S.p.A. These findings offer both contextual depth and generalizable insights into how firms navigate competitive markets characterized by low differentiation, high regulatory intensity, and increasing environmental expectations.

From the industry analysis conducted in Chapter 2, one of the most salient observations concerns the structural complexity and volatility of the concrete market. Despite its mature status, the sector continues to experience significant pressure from

macroeconomic cycles, inflation in raw material costs—particularly cement and energy—and supply chain disruptions. The regional nature of concrete production, due to the perishability and logistical constraints of the material, further fragments the competitive landscape. This results in hyperlocal competition, where pricing strategies are often reactive and influenced by short-term tactical decisions rather than long-term differentiation.

The increasing relevance of sustainability and regulatory compliance has emerged as a central trend across the industry. Environmental certifications, public procurement criteria, and carbon-related constraints are no longer peripheral considerations but have become integral to market access and strategic positioning. Firms that invest in circular practices, emission reductions, and eco-innovation are not only responding to compliance demands but are also capturing new segments of environmentally conscious customers and public institutions³⁸.

In this context, the case of Celi Calcestruzzi S.p.A. stands out as a concrete example of strategic adaptation and multidimensional competitiveness. The company demonstrates how a medium-sized, regionally focused enterprise can maintain sustained growth and institutional recognition by integrating operational efficiency with proactive environmental management and organizational innovation. Its consistent revenue growth, reinforced by public awards such as the Industria Felix Prize, underscores the effectiveness of its managerial approach.

A key finding from the case study is the role of flexibility and decentralization within a centralized governance framework. While strategic direction remains firmly in the hands of the ownership, operational autonomy is distributed across specialized divisions, allowing responsiveness to local market dynamics. This hybrid structure supports differentiated pricing, tailored client engagement, and adaptive resource allocation—strategic advantages that would be difficult to achieve in a more rigid or purely hierarchical model.

Another critical insight pertains to pricing logic and margin management. In contrast to the assumption of uniform pricing practices in commodity markets, the firm applies a granular, cost-based pricing method adjusted by volume, client history, project complexity, and delivery logistics. This pricing flexibility, combined with control over

the value chain (from raw materials to delivery), enables the firm to protect margins even in highly competitive settings. The absence of a standardized list and the use of client-specific price construction reinforce the strategic orientation toward long-term client relationships rather than short-term market capture.

Furthermore, the company's sustained investment in digital transformation and technical modernization has proven essential in maintaining efficiency and transparency. The adoption of ERP systems, automated batching, BIM integration, and digital logistics tracking supports not only operational excellence but also client trust and environmental monitoring—key differentiators in public and large-scale private contracts³⁹.

Finally, the application of theoretical models—such as Porter's Five Forces and Game Theory—provided a conceptual lens through which to interpret both the structural environment and Celi Calcestruzzi's strategic responses. The case illustrated how firms in oligopolistic and interdependent markets engage in both tactical rivalry and strategic signaling, balancing competitive pricing with long-term reputation management. This reflects a nuanced understanding of rational behavior not as static optimization, but as an evolving interaction within a constrained and uncertain environment.

The key findings point to the importance of strategic coherence—the alignment between internal capabilities, market realities, regulatory requirements, and client expectations. Celi Calcestruzzi's trajectory illustrates that in sectors traditionally seen as low-margin and conservative, there is ample room for strategic innovation, operational sophistication, and purposeful sustainability. These findings serve as a foundation for the broader discussion in the subsequent sections, where implications for theory, practice, and policy will be further explored.

4.2 Theoretical and practical implications for the construction industry

The findings presented in this study carry important implications for both theory and practice in the field of construction management and industrial strategy. While the concrete industry is often framed as low-innovation, highly commoditized, and structurally rigid, the case of Celi Calcestruzzi S.p.A. challenges this perspective, illustrating that even in traditional sectors, firms can strategically reposition themselves by leveraging adaptive capabilities, aligning with environmental shifts, and implementing technology in contextually appropriate ways.

From a theoretical standpoint, the case study offers empirical support for contingency-based views of managerial decision-making, where rational choices are not fixed or universally optimal, but instead vary according to environmental conditions, organizational structure, and available resources. The firm's selective absorption of cost inflation, its differentiated pricing strategy, and its measured expansion plans reflect decision-making under bounded rationality—where information, time, and cognitive constraints shape strategy in realistic, rather than idealized, terms. These behaviors resonate with Simon's theory of satisficing, as well as with March's notion of organizational learning, whereby firms evolve their routines in response to feedback and change⁴⁰.

Moreover, the integration of Game Theory into strategic reasoning highlights the importance of anticipating competitors' responses and shaping market expectations through credible commitments, reputation, and signaling. The behavior observed in Celi Calcestruzzi's regional pricing strategies, plant investments, and environmental certifications aligns with theoretical models of repeated games and signaling in incomplete information environments. These insights suggest that construction firms must increasingly act with a long-term strategic horizon, incorporating cooperative and deterrent elements into their interaction with competitors, clients, and regulatory bodies⁴¹.

Porter's framework also remains highly relevant but must be refined in its application to fragmented, regionalized markets like concrete. The Five Forces model, while traditionally structuralist, gains greater explanatory power when interpreted

⁴⁰ Watson, J. (2018). *Strategy: An Introduction to Game Theory*. Norton.

⁴¹ Chopra, S., & Meindl, P. (2019). *Supply Chain Management*. Pearson.

dynamically—acknowledging the temporal and behavioral aspects of rivalry, supplier relationships, and customer power. Celi’s ability to moderate buyer power through loyalty programs, value-added services, and integrated offerings exemplifies how structural constraints can be mitigated through strategic agency.

From a practical perspective, several actionable insights emerge for firms operating in the construction materials sector. First, differentiation does not have to rely solely on product innovation. In markets where the core product (i.e., concrete) is functionally standardized, firms can differentiate through service quality, delivery reliability, environmental performance, and transparency. These intangibles become key sources of value in procurement processes and in client retention strategies. The strategic use of certifications such as CAM and ISO 14001 is not only a requirement for market access but a trust signal that reduces uncertainty for institutional buyers.

Second, the findings underscore the importance of vertical integration and local responsiveness. Firms that control their upstream supply chain and operate within a defined regional perimeter can exploit economies of proximity, logistical efficiency, and regulatory familiarity. This operational model enables both cost control and rapid adaptation to localized market conditions—an advantage that is particularly salient in sectors where transportation costs and delivery timing are critical constraints.

Third, environmental sustainability must be internalized as a source of innovation and value creation, not merely as a compliance obligation. Celi Calcestruzzi’s investments in circular economy practices and green energy not only reduce operational costs over time but also enhance eligibility for public projects and attract clients who increasingly prioritize ESG (Environmental, Social, and Governance) criteria. The convergence of environmental responsibility and strategic marketing offers a compelling case for sustainability-driven competitiveness.

Fourth, digitalization and automation, while resource-intensive, offer substantial returns in terms of efficiency, coordination, and data-driven management. The adoption of ERP systems, digital batching, and BIM integration allows for better cost monitoring, more accurate project execution, and enhanced client communication. These technologies can reduce operational frictions, mitigate risk, and create value-added capabilities that distinguish a firm even in low-margin environments.

Lastly, the study highlights the relevance of organizational design and internal coordination. The success of Celi Calcestruzzi in managing a diverse portfolio of business units illustrates the advantage of hybrid governance structures that combine strategic centralization with operational decentralization. Empowering plant managers and unit leaders to make tactical decisions, while maintaining strategic coherence at the corporate level, enhances both responsiveness and alignment.

In summary, the theoretical and practical implications of this study reaffirm the value of integrating strategic management principles with real-world operational insight. For the construction industry, this means moving beyond reactive cost control toward proactive strategy formulation that incorporates sustainability, technology, and organizational learning. The Celi Calcestruzzi case demonstrates that such an approach is not only possible but increasingly necessary for long-term resilience and competitive success in a sector undergoing structural transformation.

4.3 Strategic recommendations for firms in the sector

Drawing on the integrated analysis of industry dynamics and firm-level behavior presented in this thesis, a series of strategic recommendations can be articulated for firms operating in the concrete and construction materials sector. These recommendations are intended to provide actionable guidance for practitioners facing increasingly complex operational, regulatory, and competitive environments, while also aligning with the theoretical frameworks of managerial decision-making, competitive strategy, and organizational adaptation.

Firms in this sector are encouraged to adopt a multi-lever competitive strategy. As demonstrated by the case of Celi Calcestruzzi S.p.A., success in fragmented and price-sensitive markets often depends on the ability to combine cost efficiency with service differentiation and sustainability credentials. Relying exclusively on price competition proves insufficient and risky, particularly in industries marked by high fixed costs and fluctuating input prices. Instead, companies should develop layered strategies that balance operational excellence, environmental performance, and responsiveness to client needs. Strategic resilience, in this sense, derives from the capacity to shift between cost leadership and value-added positioning based on the scale of the project, the profile of the client, and the regulatory environment.

Central to this approach is the need to embed sustainability directly into the business model. Environmental responsibility is no longer a peripheral concern, but a fundamental criterion for long-term competitiveness. Proactive alignment with environmental standards such as CAM and ISO 14001, alongside investment in green technologies like recycled aggregates, energy-efficient machinery, and low-carbon concrete mixes, positions firms to access new market segments and institutional clients. These sustainability measures should not be isolated initiatives but fully integrated into product development, procurement, logistics, and marketing functions.

Equally important is the strengthening of vertical integration and local market anchoring. The logistical constraints of ready-mix concrete and the perishability of the product make proximity and supply chain control vital for competitive advantage. Reducing

dependence on external suppliers through direct ownership or stable partnerships enhances supply reliability and cost predictability. At the same time, cultivating a strong regional presence through distributed plants and locally embedded teams improves agility, reinforces reputation, and supports responsiveness to localized procurement frameworks.

To maintain profitability in such conditions, firms must also invest in adaptive pricing strategies and margin management systems. Static pricing models fail to reflect the real-time complexity of market conditions. By implementing digital costing systems, monitoring input prices dynamically, and applying customer segmentation analytics, companies can make more precise and strategic pricing decisions. Moreover, incorporating margin management into the sales process—rather than applying it retroactively—helps firms distinguish between strategically valuable and merely opportunistic projects.

Accelerating the adoption of digital and automation technologies is another critical step for firms aiming to thrive in this environment. The transformation of the construction value chain, from design through execution, increasingly demands digital integration. Platforms such as ERP systems, automated batching units, delivery tracking software, and Building Information Modeling (BIM) are becoming standard requirements⁴². These tools enhance coordination, improve safety, reduce waste, and increase transparency—resulting in better client satisfaction and operational consistency.

To sustain long-term performance, firms should develop strategic foresight and innovation capabilities. In an era of regulatory flux and technological acceleration, companies must be able to anticipate shifts in materials, market expectations, and policy regimes. This can be achieved by establishing dedicated innovation teams, engaging in partnerships with universities or research institutions, participating in industry consortia, and leveraging innovation funding programs. These actions promote organizational learning and help build ecosystems capable of generating sustainable competitive advantages.

Organizational structure also plays a key role in strategic agility. A balanced governance model—one that centralizes strategic direction while granting local units or plant managers tactical autonomy—can yield the dual benefits of coherence and flexibility⁴³.

⁴² Deloitte (2022). *Construction 4.0*.

⁴³ McKinsey & Company (2021). *Construction's Next Normal*

As evidenced in the case of Celi Calcestruzzi, such hybrid structures enable firms to respond to regional variations in demand, pricing, and client behavior while maintaining alignment with broader corporate objectives.

Finally, in markets characterized by repeated interaction, dense stakeholder networks, and complex public-private relationships, firms may benefit from reframing competition as cooperative engagement when strategically appropriate. Joint ventures, consortia, and coordinated sustainability efforts can provide access to scale, reduce risk exposure, and shape shared standards that benefit all participating firms. This form of "co-opetition," when carefully managed, does not compromise competitive integrity but rather strengthens a firm's long-term strategic position.

In conclusion, the strategic landscape for construction material firms is becoming more demanding, but also increasingly rewarding for those equipped with vision, flexibility, and discipline. As environmental, technological, and regulatory pressures reshape the industry, companies that shift from reactive tactics to coherent and forward-looking strategies will not only endure the transition but emerge as leaders within it. The recommendations outlined here offer a roadmap for navigating this transformation, grounded in both empirical evidence and theoretical rigor.

4.4 Limitations of the study and future research directions

While this thesis has aimed to offer a theoretically robust and empirically grounded analysis of strategic behavior in the concrete and construction materials industry, several limitations must be acknowledged. These do not undermine the validity of the conclusions, but rather define the analytical boundaries of the study and highlight opportunities for further scholarly investigation.

One of the most evident limitations is the use of a single-case study approach. Although the choice of Celi Calcestruzzi S.p.A. allows for a deep and context-rich exploration of strategic decision-making in a medium-sized, regionally embedded firm, the insights derived remain inherently bounded. The firm's specific governance structure, vertical integration, and operational context may not be fully generalizable to other types of firms—such as large multinational conglomerates, micro-enterprises, or cooperatives operating under different legal, institutional, or cultural frameworks. As Robert Yin (2014) has argued, single-case studies are powerful for analytic generalization, not for statistical inference⁴⁴. Future research should therefore consider comparative or multiple-case study designs, possibly incorporating firms across different regions or countries to better capture the influence of contextual variables on strategic behavior.

A second limitation concerns the availability and nature of data sources. This study relies primarily on secondary data, industry reports, and publicly available information. While such data offer valuable insights, they lack the granularity and richness that primary data collection—such as semi-structured interviews with decision-makers, employee surveys, or client feedback—could provide. These methods would allow for a more nuanced understanding of how strategic decisions are formulated, negotiated, and implemented at different levels of the organization. Moreover, they would help to surface informal processes, tacit knowledge, and intra-organizational dynamics that are typically invisible in official reports or corporate communications. Future studies employing mixed-methods approaches would not only enhance empirical robustness but also enable triangulation between perceived, enacted, and formalized strategies.

Additionally, the research is geographically bounded within the Italian context, where public procurement rules, environmental compliance norms, and regional administrative variability significantly shape business practices. These institutional characteristics—such as Italy’s strong role of the state in construction planning, the complexity of regional authorizations, and the growing emphasis on sustainability certifications—may limit the applicability of findings to countries with different legal or economic structures. Expanding future research to include cross-national comparisons would help clarify which strategic behaviors are culturally or institutionally contingent, and which are more universally effective across the global construction industry.

Another limitation lies in the temporal scope of the study. Although the analysis includes current market trends and recent strategic investments, it remains essentially cross-sectional. Given the long-term nature of infrastructural investment, regulatory adaptation, and technological diffusion in this industry, a longitudinal perspective could significantly enrich the analysis. Tracking how strategic initiatives evolve over time—particularly in response to economic cycles, regulatory changes, or technological disruptions—would enable researchers to distinguish between short-term adaptations and durable transformations.

Perhaps the most significant limitation is theoretical. The study draws heavily on classical frameworks such as Porter’s Five Forces and Game Theory to analyze structural pressures and strategic interactions. While these models offer clarity and conceptual discipline, they also carry important limitations. Porter’s model, for example, is rooted in assumptions of relatively stable industry structures and clear-cut market boundaries. It tends to downplay the role of non-market forces, such as environmental regulation, political lobbying, public-private partnerships, and institutional legitimacy—factors that are increasingly central to firm success in the construction materials sector. Moreover, Porter’s structuralist approach may underrepresent the dynamic, process-oriented aspects of strategy—such as innovation, learning, and adaptation.

Game Theory, similarly, is based on stylized assumptions of rational players, complete (or at least probabilistically known) information, and equilibrium outcomes. These conditions are rarely met in complex, highly regulated, and fragmented markets like construction, where strategic decisions are influenced by bounded rationality, incomplete contracts, and institutional ambiguity. While useful for interpreting pricing behavior, signaling, or deterrence, Game Theory may not capture the full range of strategic considerations faced by managers navigating environmental uncertainty, policy shifts, or stakeholder pressures.

To address these theoretical blind spots, future research should explore alternative and complementary frameworks. Dynamic capabilities theory (Teece, Pisano & Shuen, 1997) offers a promising lens to examine how firms build, integrate, and reconfigure resources in response to changing environments. Likewise, Institutional Theory and Stakeholder Theory can illuminate the ways in which firms are embedded in broader social, regulatory, and normative systems, and how they gain legitimacy, shape compliance, or influence policy through strategic behavior. Incorporating these perspectives would enable a more holistic understanding of how construction firms respond to complex, multi-level pressures and opportunities.

Future research could also benefit from greater attention to emerging cross-sectoral trends. For instance, examining the interplay between digital transformation, environmental sustainability, and workforce upskilling would provide valuable insight into how construction firms manage competing priorities⁴⁵. Studies that link sustainability performance with financial or operational indicators could also test whether environmental strategies translate into measurable competitive advantage. Similarly, analyzing the role of collaborative platforms, innovation networks, and public-private consortia would help clarify how firms leverage external partnerships in pursuit of long-term resilience.

While this thesis offers a solid foundation for understanding managerial decision-making and strategic adaptation in the concrete industry, it also highlights the need for broader, deeper, and more methodologically diverse inquiries. By engaging with alternative theoretical frameworks, expanding empirical scope, and adopting longitudinal and comparative designs, future research can contribute more fully to our understanding of how construction firms navigate complexity, uncertainty, and transformation in a world where stability is no longer the norm, but the exception.

This chapter has served as a critical point of synthesis, translating the empirical insights and theoretical frameworks developed in earlier sections of the thesis into broader reflections and implications for the construction materials industry. Drawing upon the comprehensive industry analysis and the case study of Celi Calcestruzzi S.p.A., the discussion has offered a multifaceted interpretation of how firms navigate competitive environments shaped by structural constraints, regulatory obligations, technological shifts, and evolving sustainability imperatives.

The key findings discussed in Section 4.1 emphasized the complexity of market dynamics in the concrete sector and illustrated how companies can leverage internal resources and strategic flexibility to maintain competitiveness. Section 4.2 expanded these insights into a broader theoretical and practical context, linking firm-level decisions to the larger frameworks of managerial rationality, adaptive behavior, and industry transformation. The interplay between structural forces and strategic agency was further elaborated in Section 4.3, where a set of integrated recommendations highlighted the importance of multi-lever strategies, sustainability integration, digital investment, and organizational design for firms seeking to succeed in increasingly volatile environments.

Section 4.4 provided a self-reflective examination of the limitations of the study, with particular attention to methodological boundaries and theoretical assumptions. It also outlined future research avenues that could deepen the understanding of strategic decision-making in the construction industry through comparative designs, longitudinal data, and alternative conceptual lenses.

Taken together, the arguments developed in this chapter support the central proposition of the thesis: that effective strategy in the construction materials sector requires a dynamic balance between structural awareness, institutional engagement, operational excellence,

and adaptive innovation. In a sector traditionally perceived as slow-moving and cost-driven, firms that embrace complexity and proactively engage with change—rather than merely react to it—can carve out sustainable competitive positions.

As the final chapter will further elaborate, these reflections carry implications not only for managers and practitioners but also for policymakers, researchers, and educators seeking to foster resilience and innovation in industries at the crossroads of infrastructure, regulation, and environmental transition.

CONCLUSION

This thesis set out to explore strategic behavior and managerial decision-making in the concrete and construction materials industry, through a combined theoretical, sectoral, and firm-level perspective. By integrating classical and contemporary strategy frameworks with an in-depth case study of Celi Calcestruzzi S.p.A., the research has demonstrated how firms operating in a seemingly stable and commoditized sector face, and respond to, multifaceted pressures—from pricing volatility and regulatory demands to environmental imperatives and technological transformation.

One of the central findings of this study is that the concrete market, while often perceived as rigid and low-margin, is in fact structurally complex and dynamically evolving. Despite the physical immobility of the product and the apparent homogeneity of its applications, the market is shaped by highly localized competition, cost-sensitive procurement models, rising environmental expectations, and an expanding regulatory framework. Within this context, managerial decisions are rarely simple or deterministic. Instead, they emerge from a process of continuous adjustment, learning, and balancing among competing objectives.

The case of Celi Calcestruzzi S.p.A. offers a compelling example of how theoretical models of competitive strategy and decision-making can be translated into real-world organizational behavior. The firm has succeeded in a highly competitive sector not by competing solely on cost, but by crafting a hybrid strategy that integrates operational efficiency, environmental differentiation, service customization, and strategic responsiveness. Its ability to centralize strategic direction while empowering decentralized operational units enables it to act with both consistency and agility. Furthermore, its pricing approach—based not on standardized lists but on flexible, project-specific calculations—illustrates a decision-making logic that blends experience, cost awareness, and client engagement, resonating with models of bounded rationality and contextual rationality discussed in the literature.

The theoretical frameworks applied in the thesis—namely Porter’s Five Forces and Game Theory—have provided useful lenses to analyze industry structure and strategic

interaction. Porter's model helped explain the structural constraints and sources of competitive pressure in the concrete sector, while Game Theory illuminated the interdependent behavior of firms engaged in repeated market interactions. However, both frameworks also revealed their limits when confronted with the institutional complexity and dynamic change that characterize contemporary construction markets. The assumptions of stability, equilibrium, and full rationality inherent in these models often fail to capture the adaptive, path-dependent, and legitimacy-seeking behaviors that increasingly define firm success in this space.

For this reason, the study also highlighted the value of complementing classical strategy models with alternative theoretical lenses. Frameworks such as dynamic capabilities theory, institutional theory, and stakeholder theory offer richer tools for understanding how firms not only compete, but evolve—learning, adjusting, and positioning themselves within complex policy, environmental, and social ecosystems. These approaches are particularly relevant in a sector that is not only undergoing technological change, but also facing profound shifts in public expectation, procurement criteria, and environmental compliance.

Sustainability has emerged as both a constraint and an opportunity throughout this research. What was once seen as a compliance burden is now a central axis of strategic differentiation. Celi Calcestruzzi's proactive investments in green certifications, recycled materials, hybrid vehicles, and energy efficiency have enabled it to align with policy trends, qualify for public tenders, and position itself as an environmentally responsible partner. This evolution reflects a broader industry shift where sustainability is no longer a marginal concern, but a driver of innovation, legitimacy, and long-term competitiveness.

Nevertheless, the thesis acknowledges its own boundaries. The use of a single-case study design, the reliance on publicly available data, and the geographical focus on the Italian market limit the generalizability of the findings. Moreover, the static nature of the analysis, constrained to a specific moment in time, does not capture the full dynamic evolution of strategies, technologies, and policies in the years to come. Addressing these limitations, future research should embrace comparative case studies, incorporate longitudinal data, and explore alternative theoretical frameworks that account for institutional dynamics and emergent complexity.

Ultimately, this thesis affirms that effective managerial decision-making in the concrete industry requires more than just operational control or cost management. It demands strategic vision, contextual awareness, and an adaptive mindset capable of navigating regulatory constraints, environmental imperatives, and technological disruption. Firms like Celi Calcestruzzi succeed not by resisting change, but by embedding it into their organizational DNA—transforming complexity into opportunity.

In an industry often overlooked by strategic theorists, this research contributes to a growing body of knowledge that views construction not as a static or backward sector, but as a fertile ground for studying how strategy unfolds in uncertain, regulated, and materially intensive environments. As the sector continues to evolve, so too must our understanding of what it means to decide, to lead, and to compete.

Undertaking this thesis has represented not only a valuable academic exercise, but also a deeply formative personal and professional experience. As a student of management with a particular interest in strategic decision-making, I found in the concrete industry—often perceived as static and unchanging—a surprisingly rich terrain for exploring complexity, innovation, and adaptation. The opportunity to analyze Celi Calcestruzzi S.p.A., a company with which I have a direct connection, added further depth to this process, allowing me to combine theoretical models with first-hand understanding of real organizational dynamics.

This project allowed me to apply abstract strategic concepts—such as Porter’s competitive forces, game-theoretic reasoning, and bounded rationality—to practical questions of pricing, investment, innovation, and compliance in a sector where such models are rarely tested. It has challenged me to think critically, to navigate between theory and practice, and to appreciate the nuances of decision-making in environments marked by regulatory pressure, environmental transition, and operational constraints.

Beyond its academic value, this thesis has helped me cultivate a more analytical, structured, and reflective approach to complex business problems—skills that I am confident will be essential as I transition from the academic world into professional management contexts. I also believe it has deepened my awareness of how even traditional industries are undergoing profound change, and how managers must now lead not only for efficiency, but for sustainability, innovation, and resilience.

This thesis has adopted a qualitative research strategy grounded in a single, in-depth case study supported by a structured theoretical framework. The methodological rationale for this approach lies in the need to explore in detail how managerial decision-making theories manifest in the strategic behavior of firms operating in complex, regulated, and industrially specific environments. Given the scope and purpose of this research, the single-case design—focused on Celi Calcestruzzi S.p.A.—was selected for its explanatory richness and its ability to link macro-level industry dynamics with micro-level strategic choices.

Primary data collection through interviews and internal company documents was not feasible within the constraints of this project; however, this limitation was addressed through triangulation of publicly available sources, company communications, industry reports, and academic literature. The theoretical analysis was informed by classical models (Porter, Game Theory) and complemented by critical reflection on their applicability to contemporary business contexts.

It is important to acknowledge that the study's findings are intended to be analytically generalizable rather than statistically representative. The interpretations offered reflect a specific context—geographically, industrially, and organizationally—and should be read accordingly. Nonetheless, the insights derived may serve as a useful foundation for future research, particularly for scholars and practitioners seeking to better understand strategy formulation in traditional industries undergoing transformation.

BIBLIOGRAPHY

Barney, J. B. (1991). Firm Resources and Sustained Competitive Advantage. *Journal of Management*, 17(1), 99–120.

Eisenhardt, K. M. (1989). Building Theories from Case Study Research. *Academy of Management Review*, 14(4), 532–550.

Grant, R. M. (2016). *Contemporary Strategy Analysis* (9th ed.). Wiley.

Porter, M. E. (1980). *Competitive Strategy: Techniques for Analyzing Industries and Competitors*. Free Press.

Porter, M. E. (1985). *Competitive Advantage: Creating and Sustaining Superior Performance*. Free Press.

Porter, M. E. (2008). The Five Competitive Forces That Shape Strategy. *Harvard Business Review*, 86(1), 78–93.

Teece, D. J., Pisano, G., & Shuen, A. (1997). Dynamic Capabilities and Strategic Management. *Strategic Management Journal*, 18(7), 509–533.

Watson, J. (2018). *Strategy: An Introduction to Game Theory* (3rd ed.). W. W. Norton & Company.

Yin, R. K. (2014). *Case Study Research: Design and Methods* (5th ed.). SAGE Publications.

Zott, C., Amit, R., & Massa, L. (2011). The Business Model: Recent Developments and Future Research. *Journal of Management*, 37(4), 1019–1042.

Zhang, S., & Li, H. (2020). Current Applications of Game Theory in Construction Engineering and Management Research: A Social Network Analysis Approach. *Journal of Construction Engineering and Management*

Mwangi, M. (2013). Application of Porter's Five Forces Model on the Performance of Cement Industry in Kenya. *International Journal of Business and Management*,

Tsai, W.-H., & Lin, W.-H. (2024). Production Decision Model for the Cement Industry in Pursuit of Carbon Neutrality: Analysis of the Impact of Carbon Tax and Carbon Credit Costs. *Sustainability*.

Safar, M., Reinsma, S., Haas, C. T., Goodrum, P. M., & Caldas, C. H. (2016). A Decision-Making Method for Choosing Concrete Forming Systems. *International Journal of Construction Management*.

Kumar, S., & Rao, P. (2010). Global Cement Industry: Competitive and Institutional Dimensions. MPRA Paper No. 24464.

Selten, R. (1975). Reexamination of the Perfectness Concept for Equilibrium Points in Extensive Games. *International Journal of Game Theory*.

Nash, J. F. (1950). Equilibrium Points in n-Person Games. *Proceedings of the National Academy of Sciences*

Osborne, M. J., & Rubinstein, A. (1994). *A Course in Game Theory*. MIT Press.

Laffont, J. J., & Tirole, J. (1993). *A Theory of Incentives in Procurement and Regulation*.

Porter, M. E., & Kramer, M. R. (2011). Creating Shared Value. *Harvard Business Review*

Yin, R. K. (2018). *Case Study Research and Applications*. Sage Publications.

Deloitte (2022). Construction 4.0

McKinsey & Company (2021). Construction's Next Normal.

Federbeton (2022). *Analisi della filiera italiana del cemento e calcestruzzo*.

Cembureau (2022). The Role of Cement in a Circular Economy.

ANCE (2022). Digitalizzazione nell'edilizia italiana: stato dell'arte e prospettive

ReMade in Italy (2023). Certificazione CAM per il settore edilizio.

www.celiccestruzzi.it

www.industriafelix.it